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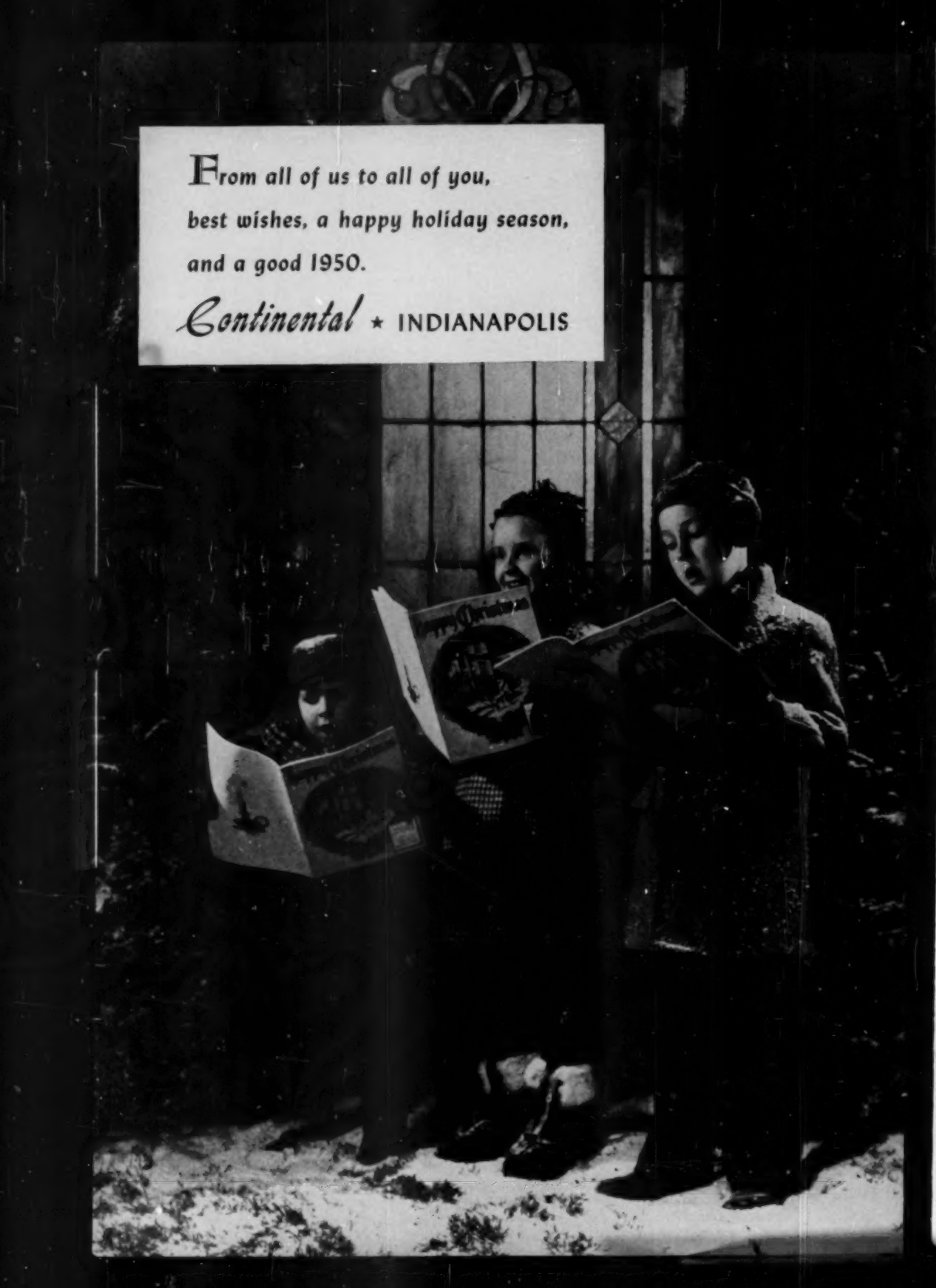
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Vol. 26 — No. 12

CONTENTS

ORIGINAL PAPERS

Psychological Aspects of Amblyopia. Louis Wekstein 511

Clinical Indications for Prescribing Prisms—With three Case Reports. Rudolph T. Textor 519

A Comparison of Peripheral Stereoscopic and Visual Acuities. V. J. Ellerbrock 530

Reducing a Cylindrical Correction. Howard T. Lewis 538

High Distance Visual Acuity with Uncorrected Astigmatism—A Case Report. R. A. Phillips 543

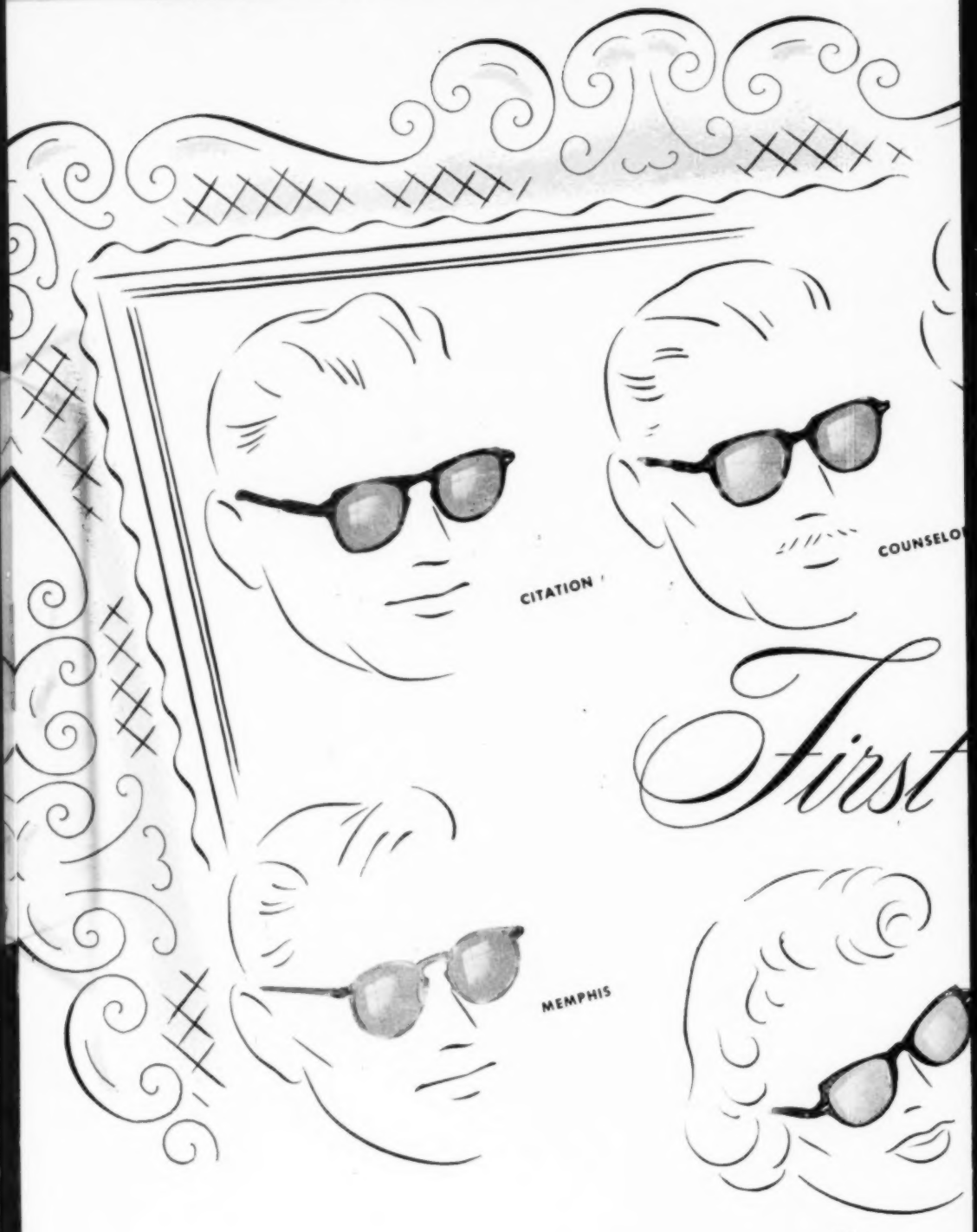
EDITORIALS

Excerpta Medica—A New Service. V. J. Ellerbrock 545

A Christmas Wish from the Staff 547

CURRENT COMMENTS 548

1950 Annual Index 551-556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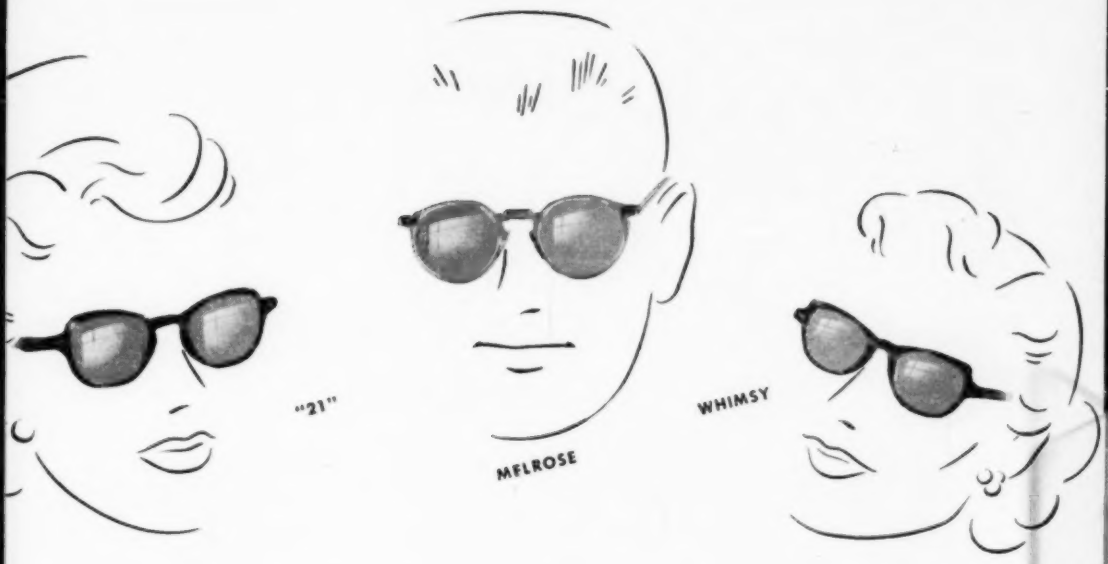

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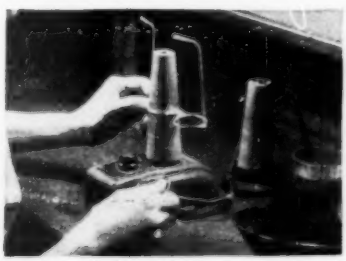

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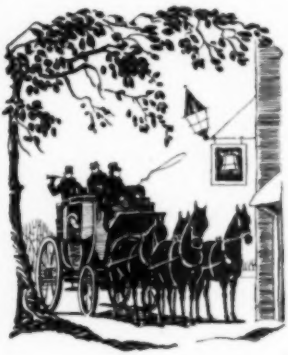

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Vol. 26 DECEMBER, 1949 No. 12

PSYCHOLOGICAL ASPECTS OF AMBLYOPIA*

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There is no question of doubt that many factors enter into the visual condition termed amblyopia. It is not the aim of this paper to infer that only psychological factors are operative and that other causes are nonexistent or inconsequential.

All too frequently the psychological approach has been criticized and maligned because of the mistaken notion that such an approach fails to take other than a psychogenic view into consideration. Nothing could be further from the truth. Melodramatic newspaper accounts and movie versions of psychodiagnosis and psychotherapy have spread so much misinformation that not only laymen but physicians and other professional men have been seriously misled.

A brief account of the psychological, or better still psychosomatic approach in disease might prove to be a valuable preface to this paper, for without it the psychological aspects of amblyopia could not be understood.

The human being is a gestalt—a totality. Through the genes of his parents he inherits a particular type of physique, height, eye color and facial characteristics. This alone however does not constitute an individual for an individual also has a personality. The personality represents in addition the sum total of the various experiences and interactions that the human being has encountered in his milieu. They constitute the aggregate of millions of stimuli that have and are impinging on the individual.

The symptoms of disease or maladjustment, which is a form of disease, represent an attempt on the part of the organism to adjust or

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adapt in the face of some adversity—to attain homeostasis. The causes of disease are, of course, multiple. It may come about as a result of inherited or congenital defect. It may be due to arauma or accident affecting the structure and function of the body. It may be due to toxic substances, to poisons that upset the organism. It may be due to germs or viruses, or substances not yet known to medical science which have the capacity to upset and in some cases to destroy the organism. But, this disequilibrium and its subsequent symptomatology may also be of psychogenic origin. As a matter of fact, in many instances it may be impossible to separate the physiological elements from the psychological ones. They may be inseparably interrelated. One may aggravate the other in a reciprocal relationship. Almost 30 years ago the ophthalmologist, Mohr, brought this forth in calling attention to the interconnection of ocular disease with general disease and with the statement that wherever psychic factors play a part in general disease, the ocular symptoms are also indirectly influenced by psychic factors.

The effects of emotions on bodily changes are becoming well known and they can be simply illustrated. The emotion of anger or rage results in a dilation of the pupils, hypertension, increase in blood sugar, tachycardia, free perspiration and a host of other changes.

Imbued by the psychosomatic viewpoint, medical men today have accepted the fact that disease cannot be understood and combatted by the mere application of scientific principles to bacteriology, physiology and biochemistry. Emotions and the effect they have on disease must be evaluated with equal diligence. Not only must the emotions be studied but all the diverse forces, all the multiple factors, all the nuances that man meets in his struggle to adjust in his particular social orbit must be carefully analyzed and appreciated as a part of the organism's general configuration.

It would be fine indeed if we could train the physician who would be a logical candidate, to study disease from such a totalistic context. Unfortunately this is virtually impossible. No human being exists who could possibly become sufficiently proficient in all the disciplines that pertain to such a detailed study of the creature we call man. It would require at least five lifetimes. We can attain this goal only by team work and cooperation between the sciences. This teamwork is now increasingly evident to all familiar with current research. Barriers have been gradually breaking down and the physician who at one time considered himself to be the sole individual competent to deal with the problems of human ills has invited others to join him in this endeavor. The psychologist, the physical anthropologist, the ethnologist, the

criminologist, the penologist, the sociologist and others may be called in when the situation warrants it as members of the team.

Such a team would be required to really deal with the complexities that manifest themselves in such an illness as amblyopia. Let me illustrate the great need for such research by the following questions which suggest themselves. What is the incidence of amblyopia in other cultures or in primitive groups still extant? Does the incidence of amblyopia correlate in any way with a Dionysian or Appollonian society, or with the manner in which children are socialized or with the family constellation? Under what socio-economic conditions is it most likely to occur in our society? Is it more common in the army, the navy or the airforce, or in prisons or among the population at large?

Although an attempt is being made to answer some of these questions, there is no organized, systematized project underway and we rely on individual investigators for piecemeal information. For example, Wechsler, a neurologist as quoted by Yasuna, states that hysterical amblyopia is rare in civilian practice but that it is relatively frequent in the service. Eames found a greater incidence of amblyopia among children who were poor readers.

I would like to discuss amblyopia from the point of view of my particular discipline, psychology.

First, a definition of amblyopia. Amblyopia from the Greek means "blunt eye." It is a condition in which vision is poor and cannot be raised to normal with lenses, although at the same time there is no apparent pathology.

Strictly speaking, the term amblyopia should be used when there is no pathology—when the condition is diagnosed as functional. When due to pathological changes, the term amaurosis should properly be used. However, in the literature both terms are used interchangeably. Ophthalmologists and other clinicians usually qualify their diagnoses with a prefix. Eg. Neurotic amaurosis, hysterical amblyopia, functional amblyopia, etc.

Numerous causes for the disease have been advanced on an organic basis. Opacities, scars and turbidities which result in impairment and prevent the formation of a clearly defined retinal image may bring on the condition. Toxic substances such as wood alcohol, arsenic lead, quinine, tobacco and the poisons from uremia may give rise to an optic neuritis which is held responsible. Recently malnutrition with subsequent avitaminosis was suggested. Other possibilities are local macular pathologies, congenital and endocrinological disease.

The crying need for research is strikingly demonstrated when one

carefully examines some of the causes listed above with psychological orientation. Why doesn't every patient with an opacity or a scar or turbidity develop an amblyopia? How much of the blindness is due to turbidity and opacity and how much is due to feelings of guilt, to anticipatory fantasies of punishment, to anxieties about going blind? It is not enough to describe the patient as nervous and apprehensive.

Why does toxicity affect some people so dramatically? During the war, many cases of amblyopia in the Low Countries were ascribed to the poor quality of the tobacco. Admittedly the tobacco probably had a good deal to do with the disease, but these people suffered also from the emotional strain of war and the insecurity of their status under enemy control. It would have been interesting to study those patients who were afflicted and compare them with those who smoked large amounts of the same tobacco and remained comparatively well.

The same objections can be raised to dietary deficiency and avitaminosis as a cause. Many of these cases were found in devastated areas and prison camps. Was it just the diet that caused the amblyopia? Could it not be as Moersch has put it that the amblyopia serves as a convenient curtain that shuts out unpleasant experiences from visual memory?

The very fact that not all cases subjected to the same stimuli react with amblyopia is provocative and should be investigated not by an ophthalmologist alone but by a clinical team with each member utilizing the special technique of his science.

It must be emphasized as stated by Wechsler in his text on clinical neurology that there is hardly a sign or symptom of organic disease which hysteria cannot simulate.

Many physicians thought that if the offending substance of the amblyopia in their opinion, was removed and the patient made a recovery then that particular substance or circumstance was definitely responsible for the disease. This attitude sounds logical but it is quite naive.

The man subjected to sadistic treatment in a German prison camp with malnutrition who reacted with amblyopia was said to recover because of a return to wholesome diet and vitamin therapy. But is it not just as conceivable that he recovered his sight because he was removed from a place of torture, that his security was reinstated in the hospital by the humane treatment he received so that it was safe for him to look again?

The patient with opacity, turbidity or scar may recover in the opinion of the physician because of specialized treatment. However,

the patient may have been threatened out of proportion to the organic findings, but when the physician gave him strong reassurance that all is now well he could once more go about the business of seeing. (Incidentally not all cases respond easily to suggestion and some people remain amblyopic for years after the pathology has been cleared up.)

The inference being made here is that without the knowledge that can be gained only through the cooperation of a clinical team, treatment of amblyopia will remain a hit and miss affair. Halpern reported on 15 cases of amblyopia in the service developed while awaiting embarkation. All improved on hospitalization without therapy.

Some cases of amblyopia have been cured not in the simple manner described by Halpern but by the most adverse, incredible and ridiculous techniques. One woman who was well publicized in the newspapers developed functional amblyopia after marriage and recovered on giving birth to her first child. Numerous cases have been treated by exhortation, spiritualism, Christian Science, chiropractic and electricity.

Shastid, speaking of hysterical amaurosis following injury, described his mode of therapy in the following words, "a little tact, a little treatment, a good deal of suggestion and the trick is turned as a rule." It must be conceded that this therapy is of little avail in understanding the dynamics of the disease.

Most ophthalmologists consider themselves extremely modern and alert when they ask the patient whether he is nervous and they consider themselves psychologically wise if by some trick they remove the symptom. The patient who has been tricked into seeing is as sick and as vulnerable as he was before this therapy. Very little has been added to knowledge on psychogenic aspects of visual disturbances since Freud's paper in 1910.

Weiss and English in Psychosomatic Medicine put it as follows: "Many cases of amblyopia have been cured by hypnotism or the profound suggestion of electrical treatments. Such 'cures' are usually only temporary, however, because the underlying neurosis has not been modified. Real psychotherapy, in which the patient participates intellectually and emotionally is necessary if we are to do more than temporarily abolish the symptom."

Very little more can be added to a discussion of amblyopia beyond diagnosis and classification. However, it might be worth while to dwell on this theme. Yasuna, for purposes of convenience divides the hysterical amblyopias into three broad classifications. 1.—Acute, develops suddenly with a short course. 2.—Chronic, exists for a considerable period, does not have a definite time of onset and the course

may be complex. 3.—Mixed, other elements of psychoneurosis are present.

Moersch and Yasuna both emphasize the importance of distinguishing amblyopia from malingering but both agree that this is not always easy to accomplish. As a matter of fact both the malingerer and the hysteric are physically ill. The difference lies in the fact that the hysteric is unconscious of his somatization whereas the malingerer consciously and willfully attempts to falsify. It is important to note that tricking the patient into seeing is not proof of malingering. A number of criteria have been developed for purposes of differential diagnosis.

The hysteric is not particularly upset by his amblyopia. Since the symptoms protect him he is not especially anxious to give them up. The malingerer in trying to add credence to his disability appears very upset.

The hysteric rarely hurts himself and finds it comparatively easy to get about even with marked constriction of fields of vision. The malingerer in trying to prove his helplessness overplays his hand with his abject inability to walk in dim illumination even though the peripheral fields are normal.

The hysteric enjoys being examined: he loves the attention being paid to him and is gratified by every reexamination. The malingerer fears reexamination and is not cooperative.

In hysteria the amblyopia is more likely to be bilateral. In malingering it is more often unilateral.

The hysteric is more likely to give a picture of consistency whereas the malingerer will be less consistent because he attempts to deceive. (This, however, is not always reliable as an index.)

In an examination of the peripheral fields, the hysteric gives a tubular, concentric field with steep borders with test objects of varying size and frequently shows a reversal of color fields. The malingerer does not give such a picture.

In closing, a few theoretical considerations may not be amiss. Unfortunately we have not arrived at a stage when we can discuss amblyopia with accuracy and precision, but conjectures have frequently proved to be fruitful.

The young child with his unfolding potentialities ever increasing as a result of maturation, is extremely curious. Once he is able to walk (at about one year of age) his desire to explore and later to manipulate parts of his environment is greatly enhanced. Each new act that makes him less dependent on his parents adds to his confidence and the child is highly gratified by the feeling of strength and power.

Vision guides him in his quest for security. His comprehension is greatly increased through vision and soon he begins to understand the meaning of symbols and concepts.

To the child there is no such thing as morality—right and wrong. The parents, however, invariably in their desire to socialize the child impose their regulations and their own inhibitions. The amazed and confused child is taught that this is right—that is wrong. He is admonished not to touch that, not to go into this room. In other words, it is not safe to explore, to hear, to feel, to smell or to see everything. Certain objects and situations, the child learns, are fraught with danger. The penalty may range from a thrashing to an admonition. It usually involves a loss of love from the all-powerful, omnipotent parent. The child is told directly or it is inferred that he incurred the anger or dislike of the all-important parent on whom he is still so dependent.

One reason why the human being is capable of reaching such a high stage of development is his long infancy, during which he can not run away from the kindness and cruelties that befall him. Thus he is socialized even if he is resistant. The effectiveness of the socialization depends a good deal on how the inhibitions were imposed. At what expense to the child's personality was he taught to behave in the manner desired by the parents? Some parents are so demanding and rejecting that the ego structure of the child has had no opportunity to develop sufficiently to cope with the trauma and emergency situations that arise in living. Such persons as adults are vulnerable to emotional and subsequently physical disease as well.

To return to vision, in the course of socialization the child is told at one time or another that he must not go into his parents' bedroom, that he must not peek when they are undressing, that it is not right to look here or there. These prohibitions usually have to do with sex because in our society sex is so rigidly regulated and the young are taught these regulations almost at once.

The child who has been admonished not to look has a number of alternatives. He may continue to look despite his parents and despite some guilt feelings about his disobedience. He may obey the dictums but his general curiosity suffers and he may become quite inhibited. By the time he is ready for school the repressive socialization has already had effect. One cannot help but wonder about the socialization of the children with reading difficulties and amblyopia studied by Eames. It seems logical that children with one should suffer from the other. Amblyopia is one of the causes of dyslexia.

It is interesting to note that when a child (and many adults as well)

has done something of which he is ashamed, he will put his hands up before his eyes as if to occlude vision. In amblyopia this mechanism is carried one step further and it is not necessary to cover the eyes with the hands.

Some children persist in their peeping activity, their forbidden visual activity despite their parents' teachings. If the child is carrying on the forbidden activity at a time when one or the other parent dies or becomes sick, the child may feel that he was responsible and that this was his punishment for voyeurism. He may react with a number of conditions associated with amblyopia, namely squinting or blepharospasm. These cases are quite common and the physician who is usually called is at a loss to explain them.

In other words, if a child has been too rigidly socialized and his feelings of guilt have been well developed by punitive parents he may later in life react to crises, to trauma and emergencies by punishing himself. Unquestionably these crises may be associated with any number of organic conditions.

In the words of Freud, "Because you have chosen to use your organ of sight for evil indulgences of the senses, it serves you quite right if you see nothing at all now."

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CLINICAL INDICATIONS FOR PRESCRIBING PRISMS—WITH THREE CASE REPORTS*

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The application of prisms as a therapeutic measure has considerable value in relieving symptoms caused by muscular imbalances. Such eminent authorities as Bielschowsky, Percival, Sheard, Lancaster, Thorington and others have exhaustively researched the problems inherent in heterophorias. They have propounded that many cases seen in daily practice can be successfully treated with prismatic corrections. On the other hand, it has occurred to the author that the antipathy many refractionists have towards prescribing prisms—particularly lateral prisms—necessitates further discussion of this controversial subject.

Heterophoria is a condition of the eyes wherein one eye deviates from parallelism when fusion is abolished. In hyperphoria, the visual axis of one eye will deviate upward with respect to the other when fusion is interrupted; in exophoria, it will deviate outward, and in esophoria, inward. Quite frequently, a combination of hyperphoria and exophoria or esophoria will exist.

These statements are generally accepted definitions of the various types of muscular imbalances but the presence of the heterophoria, *per se*, does not preclude treatment. Four prism diopters base-out before each eye cannot be prescribed in the belief that this is the proper treatment for a patient with 8 prism diopters of esophoria. Likewise, it is common knowledge that many patients have a relatively high phoria but manifest no ocular symptoms. Heterophorias, therefore, are a complex problem and necessitate complete understanding and clarification before successful treatment can be given. In this regard, an effort will be undertaken to discuss the various diagnoses which should be made before an orderly picture evolves and prisms can be added to the patient's prescription with some confidence.

The history and symptoms usually afford the first indication to the examiner that the patient might be a possible heterophoric case. The history should be carefully taken with special consideration given to:

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1) the degree of comfort experienced with previous spectacles or other therapy.
2) the age of the patient.
3) the patient's health and mental stability.
4) the patient's symptoms. (onset, duration and frequency)

The relation of long-standing symptoms despite several pairs of spectacles should encourage the examiner to use his utmost care and skill to diagnose the cause of the symptoms. The patient should be interrogated further in regard to the various therapies, exclusive of refractive corrections, that have been attempted. Previous efforts might have included prismatic spectacles, aniseikonic spectacles, monocular occlusion, or the application of visual training in some form. The success or failure of any of these therapies well serve as an excellent guide.

The age of the patient should be considered in prescribing prisms. It is an established fact that the eyes tend to become more divergent with increasing years. Bielschowsky[1] has mentioned that if a child loses binocular vision, his chances of developing a convergent squint are five times as great as for a person over 30 years of age. He maintains that changes in the topographic-anatomic structures of the eyes render them more divergent with age. This increased divergence tends to demand more from the fusion faculty which actually loses its efficacy with age. Furthermore, the onset of presbyopia also interferes with convergence in those patients over 45 years of age. Scobee[2] does not mention these facts in speaking of exophorias or esophorias but in his section on vertical phoria, he states that only 33 per cent of all hyperphorias are found in patients under 30 years of age while 67 per cent occur in patients over 30. He further maintains that in youth (apparently under 30 years), there is present a strong fusion faculty and a much better tonus of the muscles which make for comfortable binocular vision.

Substantiation of Bielschowky's and Scobee's opinions is found in a recent paper by Borish.[3] He has tabulated the data for 54 cases of prismatic corrections given to correct hyperphoria and 66 cases in which base-in prisms were prescribed for exophoric cases. It will be found from his data that 60 per cent of the hyperphoric and exophoric cases were 30 years of age or over and the remaining 40 per cent were under 30 years of age. Therefore, it would seem that orthoptics or vision training would be the better expedient for adolescents or young adults than the application of prismatic corrections. Conversely, an adult is more likely to benefit by a prismatic correction.

The patient's health and mental stability often indicate the advisability of prescribing prisms. An unstable or maladjusted type of person—a business executive under considerable pressure or responsibility, a person suffering from a nervous breakdown, the suspicion of some point of focal infection, excessive use of tobacco, stimulants or drugs—these types of patients will usually manifest an unstable esophoria due to overstimulation of the convergence center. In such cases, the phoria measurement is likely to vary considerably on subsequent tests and even during the phoria measurement itself. Such patients would not be benefited by prisms and should seek another type of treatment. However, a patient normal in every other respect, should have prisms if the complete data on the case so indicate it.

There are certain symptoms that are associated particularly with heterophoric cases. Occasional diplopia when physically tired is the most obvious. Diplopia might also become apparent to the patient when the peripheral stimuli to fusion have been diminished. For example, patients may report diplopia when they are hanging clothes on a line or while watching an airplane in the sky or when reading. Vertigo, severe headaches or nausea which result if the patient is subjected to an environment wherein there is considerable motion is peculiar to heterophorias. In such instances, the patient will report dizziness, headaches or gastro-intestinal disturbances when shopping in a crowded area or when riding in a car, train or ship (car-train-sea sickness). Other symptoms in heterophoric cases are fatigue, headaches, pain in the eyes, tearing and blurred vision. These latter symptoms would be usually associated with close work.

Monocular occlusion was mentioned previously without elaboration. It is very often a most helpful expedient to employ an occluder as a diagnostic measure in the attempt to determine whether the patient's symptoms are caused by his eyes, particularly by some *binocular* dysfunction. Bannon[1] has pointed out in his paper, "Diagnostic and Therapeutic Use of Monocular Occlusion," that monocular occlusion affords a valuable clue in diagnosing a possible heterophoric or aniseikonic case.

The determination of the degree and direction of the heterophoria presents the second important diagnostic step. In his excellent treatise, "Lectures on Motor Anomalies," Bielschowsky[1] discusses the distinction between heterophorias influenced by anatomical anomalies and those imbalances which are affected by various types of innervations.

In the anatomic type of heterophoria, the muscle imbalance is influenced purely by mechanical differences, viz.: assymetry of both sides

of the head. Bielschowsky maintains that if the eyes, lids, muscle insertions, retrobulbar and other tissues, and the size and shape of the orbits were identical, orthophoria would exist. However, the eyes and their surrounding parts are usually assymetrical so that, if fusion is abolished, some type of heterophoria is expected from this factor alone. Bielschowsky states "the position of the eyes so far as it depends solely on the topographic-anatomic conditions would, *almost without exception*, result in one visual line deviating from the fixation point in one direction or another—."

Many nervous factors influence the position of rest of the eyes. Some of these nervous influences include (1) fusion innervation, (2) the association between accommodation and convergence, (3) the voluntary influences, (4) the connections between the vestibular apparatus and the oculomotor muscles, (5) the connections between the different cortical sensory and the oculomotor centers. Most of these innervations can be eliminated during the examination but there is never complete relaxation of all stimuli. The muscles, therefore, are always receiving some innervation even in sleep or when a person is under the influence of narcotics. Consequently, the *true position of rest* can never be established but that which is actually measured is the *relative position of rest*.

Fusional innervation can be eliminated to a substantial degree by an occluder as in the cover test, or by using a dissociating prism or a Maddox rod. The stimuli to fusion should remain interrupted for many minutes since it takes time for the relaxation of the compensating innervations of the eyes maintained by the fusion apparatus. Correction of any existing hyperopia and/or presbyopia should negate the effect of accommodation on convergence. The voluntary and vestibular innervations can be eliminated by cautioning the patient not to move his head, eyes or body during the measurement.

It should be reiterated that there are other innervations that cannot be completely controlled. Therefore, heterophoria tests for distance and near, should be repeated often and at various times of the day in order to establish a significant relative position of rest. In this regard, it is good policy to inform the patient that his particular case is unique and requires careful and successive examinations. Such cases, if their symptoms are of long-standing, will generally agree and will appreciate the suggestion of subsequent visits.

Vertical phorias occasionally include the peculiar problem of an alternating hyperphoria. This anomaly will be manifested when the non-fixating eye turns up under disassociation. The cover test will readily disclose this condition but if the Maddox rod is used, it should

be placed alternately before each eye. Bielschowsky believes that alternating hyperphorias are due to intermittent excitations of the centers for vertical divergence. Prisms are valueless in such cases.

The types of phoria which seem most amenable to correction by prisms fall in the anatomical category. If the phoria is of an anomalous anatomical origin, then:

(1) it will manifest consistent readings throughout successive examinations.

(2) it will not be appreciably affected by a change of gaze to the right, left, up or down.

(3) it should show a physiologic exophoria rather than physiologic esophoria.

When these conditions have been determined, it would be practicable to prescribe prisms provided the history, symptoms, age, fusional amplitudes and other factors do not vitiate the actual phoria measurements. In this regard it should be added that, although most authorities warn against the prescription of base-out prisms, such a correction might be beneficial for the relief of symptoms associated with esophoria provided that a nervous origin for the esophoria has been ruled out.

In phorias of an innervational origin, the accommodative type is most successfully treated. If the phoria is esophoria, the application of the highest convex lenses, *determined binocularly*, which does not interfere with normal visual acuity will usually be adequate. It is sometimes necessary to prescribe bifocals to patients of pre-presbyopic age when the application of more plus over and above the distance refraction materially reduces the esophoria at the near point. Incidentally, a distinction between innervational esophoria and anatomical esophoria may be determined mainly by the fact that, in the former type, the addition of convex lenses lessens the esophoria.

Assuming that the history, symptoms, and the measurement of the heterophoria have established a possible heterophoric case, the fusional amplitudes should aid materially in the final diagnosis. For this test, Risley prisms rather than the haploscope, are employed almost universally in this country.

The application of prisms base-out, in, up or down will cause the eye before which the prism has been placed to move toward the apex of the prism in order to maintain fusion. For example, if a prism is placed base-in before the left eye, momentary diplopia will result and the eye will move laterally toward the left in order to re-establish fusion. This movement is actually accomplished by the muscles themselves but the muscles are activated by innervations to all four lateral recti (their

synergists and antagonists)—not to one eye alone. When insuperable diplopia finally results, it is not the fault of a weak muscle but, rather, it is caused by the fusion reflex which may or may not be in good order.

Lancaster[5] has pointed out that diplopia does not result from a "weak muscle." He has illustrated neatly by anatomical and physiological evidence that "the extra-ocular muscles are powerful enough to exert a pull 100 times as strong as is needed to move the eye." He concludes with complete rationality (and most authorities agree) that fusional amplitudes measure the ability of the complex *fusion reflex* to cope with undue strain without producing symptoms.

Similar to taking phoria measurements, it is wise to make several determinations of the fusional amplitudes at various times and at distance and near. It is also recommended that a time lapse be allowed between measurements in order that little or no innervational effect is held over from the preceding finding. The vertical fusional amplitudes should be determined first and, if hyperphoria has been measured and substantiated, it is best to correct it before proceeding to measure the lateral fusional amplitudes. When these precautions are taken, more consistent values for the fusional amplitudes will be established.

The range of the vertical fusional amplitudes is comparatively small—in the nature of 2-4 prism diopters to the point of diplopia and 1-2 prism diopters to recovery of single binocular vision. Except in cases of alternating hyperphoria, a toxic condition, or paretic hyperphoria, there will be a fairly normal correspondence between the vertical phoria and the vertical fusional amplitudes. In this instance, it would be best to prescribe that prism which is equal to one-half the difference between the base-up-to-break and base-down-to-break measurements.

In the measurement of the lateral fusional amplitudes, the effect on accommodation when the convergence faculty has been altered by prisms has considerable value as shown by Sheard[6] whose work in this field has weathered the test of time quite well. He maintains that, for comfortable and efficient binocular vision, the fusional reserve (base-in or out to blur) must be twice the phoria measurement and he suggests the following formula for prescribing prisms:

$$\text{prism} = \tfrac{2}{3}\ \text{phoria} - \tfrac{1}{3}\ \text{blur point.}$$

If the result is negative, no prism is necessary; if positive, a prismatic correction is indicated. For all practical purposes, this criterion is perhaps the best guide to the examiner who endeavors to reach a starting point for the determination of the correcting prism.

However, it might be well to mention possible normal expected

values for the abduction and adduction measurements. Taken with the patient's refractive correction, these values in prism diopters for a person with normal eyes should be in the vicinity of:

	Abduction		Adduction	
[Distance]	blur point between	4Δ - 6Δ	blur point between	8Δ - 12Δ
	break point between	6Δ - 8Δ	break point between	16Δ - 20Δ
	recovery point between	5Δ - 6Δ	recovery point between	10Δ - 12Δ
[Near]	blur point between	10Δ - 12Δ	blur point between	14Δ - 18Δ
	break point between	14Δ - 18Δ	break point between	20Δ - 30Δ
	recovery point between	12Δ - 16Δ	recovery point between	12Δ - 16Δ

These values are predicated on an empirical basis which resulted from the author's technique. For a better understanding of normal expected values, it is suggested that the optometrist establish his own norms using his own techniques on normal cases. In this manner, a deviation from the examiner's own norms would possibly have more significance than the above figures.

When a deviation from the normal expected values occurs, the case deserves consideration for a prism prescription. If a correlation of all the foregoing data—history, symptoms, age, health, phoria measurements—point to a prismatic correction and if the fusional amplitudes are outside of normal limits, it is most proper to prescribe the prism.

By way of example, the following cases* are presented for consideration.

CASE 1

Mrs. B. S.—first seen January, 1943.

Age—27.

Occupation—secretary.

Symptoms—Frontal and temporal headaches, asthenopia and nausea. These symptoms were general in nature but definitely aggravated by a small amount of close work. Onset of symptoms was many years ago and patient received only slight relief from various refractive corrections.

Health—good: usual childhead diseases.

Old correction:

O.D. + 0.75 D. sph. ⌒ —0.50 D. cyl. axis 5. V.A. = 20/20.

O.S. + 2.50 D. sph. ⌒ —0.50 D. cyl. axis 180. V.A. = 20/20.

Phoria with above correction:

Distance, 3Δ exophoria. Near, 11Δ exophoria.

*These cases were patients at the Dartmouth Eye Institute, Hanover, N. H., where the author was a Clinical Fellow in Physiological Optics.

Fusional amplitude with correction:

	Abduction	*Adduction*	*NPC*
Distance:	10/12/8	10/12/6	20 cms.
Near:	16/20/16	14/16/12	poorly held

The following formula was prescribed for constant wear:

O.D. + 0.75 D. sph. ⌒ —.75 D. cyl. axis 10. ⌒ 2Δ base-in.
O.S. + 2.50 D. sph. ⌒ —0.50 D. cyl. axis 170. ⌒ 1Δ base-in.

The patient wrote one month later that she had complete relief from all her symptoms and that she could read for several hours with comfort. She was examined again in July, 1947, when she reported only slight asthenopia from close work but nothing unusual. At that time, her phorias and fusional amplitudes were essentially the same as before and she was given the following correction:

O.D. + 1.00 D. sph. ⌒ —1.00 D. cyl. axis 10. ⌒ 2Δ base-in.
O.S. + 2.75 D. sph. ⌒ —0.75 D. cyl. axis 170. ⌒ 1Δ base-in.

This case is obviously one of convergence insufficiency and exophoria. The data correlate very well and by comparison with the normal expected values and by using Sheard's formula, a comfortable correction resulted.

CASE 2.

Mr. T. C. M.—first seen February, 1942.

Age—46.

Occupation—manufacturer.

Symptoms—marked asthenopia, blurring of print and fatigue from close work only. Onset of symptoms was approximately two years ago. Two pair of bifocals—one recently—did not remedy the discomfort.

Health—good: recent examination revealed nothing unusual.

Old correction:

O.D. + 1.25 D. sph. ⌒ —1.25 D. cyl. axis 5. V.A. = 20/15.
O.S. + 0.75 D.sph. ⌒ —0.75 D. cyl. axis 175. V.A. = 20/15.
Add. + 1.25 D. sph. O.U. in bifocal form.

Phoria with above correction:

Distance, 2Δ exophoria. 1/2Δ left hyperphoria.
Near, 16Δ exophoria. 3/4Δ left hyperphoria.

Fusional amplitudes with correction:

	Abduction	*Adduction*	*V.D.*
Distance:	10/14/12	12/16/10	+2/1
Near:	20/24/22	12/14/12	—3/2

Correction prescribed for near work only:

O.D. + 2.25 D. sph. ⌒ —1.50 D. cyl. axis 5, ⌒ 2Δ base-in.

O.S. + 2.00 D. sph. ⌒ —1.25 D. cyl. axis 170, ⌒ 2Δ base-in.

Six months later, the patient reported in person that he experienced marked relief from his symptoms. This case also illustrates the value of base-in prisms for an exophoric - convergence insufficiency case. It differs from Case 1 merely in that the patient's symptoms resulted from close work only.

CASE 3.

Mr. T. A.—first seen October, 1937.

Age—27.

Occupation—editor of periodical magazine.

Symptoms—Frontal headaches, nervousness, fatigue and gastrointestinal disturbances more marked following close work. His symptoms began 10 years ago after an attack of encephalitis. He had many corrections with no relief until 3 years ago when he was given his present glasses. He experienced marked relief with these glasses, but his symptoms began reappearing several months ago.

The patient's health was good.

Old correction:

O.D. + 2.00 D. sph. ⌒ —0.25 D. cyl. axis 90 ⌒ 2Δ base-out. V.A. = 20/15.

O.S. + 2.25 D. sph. ⌒ —0.25 D. cyl. axis 80 ⌒ 1Δ base-out. V.A. = 20/15.

Add. + 1.25 D. sph. in bifocal form.

Phoria with above correction:

Distance, 10Δ esophoria. Near, 6Δ esophoria.

Fusional amplitudes with correction:

	Abduction	*Adduction*
Distance:	x/6/0	20/36/24
Near:	x/10/4	20/40/30

The following correction was prescribed in bifocal form for constant wear:

O.D. + 2.25 D. sph. ⌒ —0.37 D. cyl. axis 95 ⌒ 3Δ base-out.

O.S. + 2.50 D. sph. ⌒ —0.37 D. cyl. axis 80 ⌒ 3Δ base-out.

Add. + 1.00 D. sph. O.U.

It should be mentioned that, with the above correction, the patient's phoria for distance was 4Δ esophoria and he had orthophoria at 16 inches. Without the addition of + 1.00 spheres O.U., it is also significant to note that the patient manifested 6Δ esophoria at the near point.

Case 3 is unique in that it illustrates a reduction of the phoria with the application of base-out prisms and a further reduction results at the near point with the addition of plus spheres. This case, because of the physiologic exophoria, might be considered in the anatomical category thereby warranting the use of base-out prisms. The reduction of the near phoria with the application of plus spheres further suggests a faulty innervational pattern.

SUMMARY AND CONCLUSIONS

Prisms have a definite value in affording relief of symptoms that have not been alleviated by refractive spectacles. Prior to a satisfactory prismatic correction, several considerations must be contemplated. These are:

1. That the history indicates several therapies which have been attempted without success.

2. That the symptoms are persistent.

3. That the age of those patients most adaptable to prismatic correction is in the adult age group.

4. That the health of the patient is satisfactory and that his mental stability is fairly normal.

5. That monocular occlusion will prove or disprove a binocular abnormality; i.e., heterophoria or aniseikonia.

6. That the measured phorias are true phorias; i.e., those phorias in which the various nervous influences are minimized to a large degree.

7. That the anatomical type of phoria, including esophoria, can be most successfully treated.

8. That the fusional amplitudes determine the existence of a malfunction of the fusion reflex in the direction of the phoria.

9. That the relative rather than the absolute values of accommodation and convergence at the distance and near points should be analyzed and compared with normal expected values. From this comparison, the examiner might use Sheard's formula as a starting point in the determination of the corrective prism.

In order to illustrate the above considerations, three typical cases were presented.

In conclusion, it should be said that this paper is intended to stimulate further interest in the proper prescription of prisms for problem cases. These prescriptions are as much the direct responsibility of the optometrist in the treatment of his patients as are ordinary refractive corrections.

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ABSTRACT

REFRACTIVE TREATMENT OF ASTHENOPIA. P. W. Miles. American Journal of Ophthalmology. 32.1.111-121. 1949.

Although much progress has been made in the treatment of asthenopia since the more universal correction of hyperopia and of astigmatism, nevertheless, there is a group of "eye sufferers" who drift from one doctor to another in the hope of relief. Too often such patients are prematurely labelled "functional" by busy practitioners and it is an admission of failure to give nonspecific treatment. These patients might be referred elsewhere for treatment of asthenopia if it were not for the tendency to consider refraction as an insignificant branch of ophthalmology. As the author states, one would as soon (i.e., as unlikely) refer a patient with a stye.

This paper presents a procedure for handling difficult refractive patients. On the first visit, systemic diseases and foci of infection are considered. The refractive procedure includes: noncycloplegic refraction and motility studies, amplitude of accommodation, ductions, versions and diplopia fields, etc. Secondly, a cycloplegic refraction is done with attention to the residual accommodation. The determination of the new prescription may include considerations of: temporary glasses or clip-ons, undercorrections and spherical equivalents, precision lenses with distance from cornea to lens allowance, monocular occlusion, anisometropic and aniseikonic factors.

Specific points are offered with respect to the advantages and disadvantages of the phorometer as compared to the trial frame. The value of a Lensometer for determining accurately the nature of the old glasses is noted. Retinoscopy technique, particularly the non-cyloplegic method, is discussed at some length and presents many useful hints and helps. Also, subjective refractive techniques are discussed with emphasis on obtaining the proper fog binocularly for the determination of the astigmatism by dials and by the Jackson cross cylinders at the near point as well as for distance. The axis of astigmatism at near is frequently sufficiently different from that found for distance fixation to be clinically significant in problem cases.

Phoria studies, distance and near, and the prescribing of prisms is discussed briefly, as are tests for amplitude of accommodation and the fusional amplitudes. The author maintains that most asthenopic patients have defects in motility and fusion. A few sentences are included about orthoptics and home training. Anisometropia and aniseikonia are discussed together and slab-off prisms are recommended for anisophoria due to anisometropia. Undercorrecting the more ametropic eye, especially if it is amblyopic is advised in some cases in order to encourage suppression. A screening test for aniseikonia in the horizontal meridian may be made by the use of two small lights placed about 6 feet in front of the patient, about 18 inches apart, and viewed through a maddox rod placed before each eye over the refractive correction.

In general, this paper contains many practical hints which the beginner should find helpful in the handling of some types of difficult refractive cases.

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A COMPARISON OF PERIPHERAL STEREOSCOPIC AND VISUAL ACUITIES*

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Several investigators in the past have specifically pointed out the close agreement between the decrease in stereoscopic acuity with visual acuity for increasing peripheral angle measured from the center of the visual field. Due to the importance of this finding, the present paper was written to present and call attention to additional data on this point.[1]

MEASUREMENT OF STEREOSCOPIC ACUITY

The method of measuring the stereoscopic acuity in this investigation involved the measurement of the sensitivity of an individual to X90 meridional size differences. For all the experiments, the test objects were two vertical cords symmetrically placed on either side of the objective median plane of the observer. The separation of the cords was varied and thus the foveal as well as the different peripheral portions of the retina were investigated.

The action of a size lens on the position of the cords in the horizontal meridian of the eye is illustrated in Figure 1.[2] By its use, binocular parallax is changed from that encountered without the lens. For subjects with normal stereoscopic acuity this change is interpreted as a shift in the position of the cords in space.

APPARATUS

The apparatus for this investigation consisted essentially of three parts: the optical system, the apertures, and the test cords. The optical system includes an adjustable meridional size unit and an auxiliary size lens. The lens was used so that the cords would be equidistant to the subject at the middle of the range of the size unit.

The essential elements of the meridional size unit are a positive and

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[1]This report represents further consideration of data from a study of the stereoscopic sensitivity in the space eikonometer (Ogle, K.N. and Ellerbrock, V.J.: Arch. Ophth. 34: 303-310, 1945). In contrast to the original paper in which the experimental data was related directly to the space eikonometer, the emphasis in this report only will be upon peripheral stereoscopic acuity and its relation to peripheral visual acuity.

[2]A size lens produces magnification but has zero vertex power.

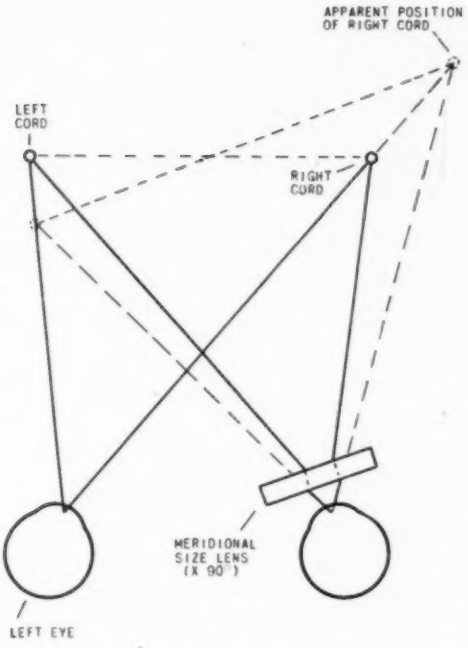

Fig. 1. Illustration of the effect of increasing the size of the retinal image in the horizontal meridian for the right eye. It should be noted that the cord on the same side as the eye with the size lens is subjectively judged to be farther than the cord on the opposite side.

a negative cylindrical lens.[3] By keeping the ocular (negative) lens of the combination in a fixed position the unit is essentially without power error, yet has a variable magnification approximately proportional to the separation. The unit could be set to 0.05 per cent with a maximum average deviation of 0.02 per cent. In all the experiments to be reported, the rear surface of the ocular lens was 3.30 cm. from the anterior surface of the cornea and provided a visual field of 17.5°.

The apertures were simple screening devices designed to restrict the field of view of the subject to the test elements (Figure 2). These provided an angular field of view of 22 degrees in the horizontal and 15 degrees in the vertical meridian.

A shutter was mounted before the right eye and in front of the

[3]Ogle, K. N.: An Optical Unit for Obtaining Variable Magnification in Ophthalmic Use. J. O. S. A., 32: 143-146, 1942.

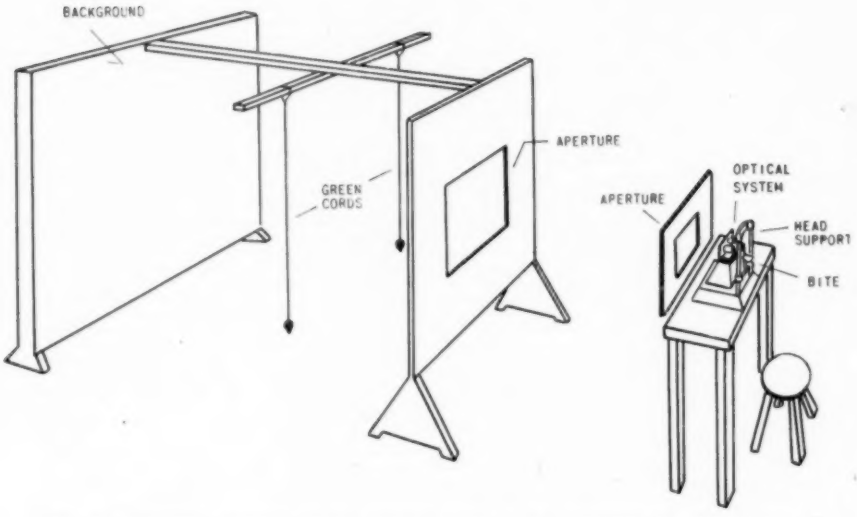

Fig. 2. Perspective drawing of the essential parts of the apparatus for determining peripheral stereoscopic sensitivity.

adjustable size unit. When lowered, it occluded the right eye except for a small region (about 1 minute of arc) seen through a hole in the center of the shutter. This hole permitted binocular fixation of a small white target, when binocular perception of the test elements was interrupted, and kept the eyes properly converged.

The head of the subject was held in a fixed position before the lens system and shutters by forehead and temple rests and a wax bite. This arrangement minimized head movements and depth perception clues from parallax.

The test elements consisted of two uniform green cords, approximately 1 mm. in diameter, which were held straight and vertical by means of plumb bobs (Figure 2). Their separation could be adjusted on a 2 M stick from which they were hung. The plane of this meter stick was very carefully adjusted so that it was perpendicular to the median plane of the subject's head and 240 cm. from the eyes. The background for the cords was a piece of uniform black velvet and located 2 meters in back of the plane of the cords.

A uniform illumination of the test elements was provided by four 18 inch (40 watt) lumiline lamps arranged in a plane and equally spaced on each side of and above and below the large aperture in front

of the test elements. With this illumination the test elements appeared to stand out vividly against the black background, without shadows. The brightness of the cords was about 0.6 millilamberts.

PROCEDURE

The constant stimulus method was used throughout this study. Five steps, which approximately covered the transition from one judgment to the other, were used in each experiment. Each stimulus value was given 40 times in a random order. The categories of response used by the subject were: the right cord in front, on the same plane, and in rear of the left cord. The subject was instructed not to use the "on plane" category unless he was unable to give the slightest preference to either of the other two.

The time for each individual experiment varied somewhat with the separation of the cords, increasing with the distance of separation. For each judgment the subject took the necessary time to arrive at what he considered to be the best possible judgment.[4] The average time per judgment was approximately two seconds with an average deviation of about one second. As soon as the judgment had been given the shutter was dropped but left in position until the magnification unit had been reset. The average time that the shutter was before the subject's eye between judgments was approximately 4 seconds. The experiment was divided into two sections, each of 100 judgments, divided by a five minute rest period.

For each experiment of 200 judgments the median and standard deviation of the best fitting ogive curve was calculated for either the "in front" or the "in rear" data (Figure 3).[5] The number of judgments in the middle category, which were always very few, were divided proportionately between the "in front" and "in rear" data. The method of least squares using the Mueller Urban weights was employed to fit the ogive curve and compute the standard deviation (δ).[6]

---

[4]During the time that the test elements were visible to both eyes the subject was permited to fixate either cord and to change fixation from one cord to the other. It is possible that different values of stereoscopic acuity would be found if changes of fixation were not permitted.

[5]An ogive curve for a given set of data can be described quantitatively by a given constant, σ, the so-called standard deviation. This quantity is therefore generally accepted as a measure of accuracy of any series of responses. Roughly, it is only slightly smaller than the average deviation of a series of settings if the subject were to adjust the magnification units. The smaller δ becomes, the steeper is the central part of the curve and the smaller is the threshold value. A small δ would then indicate a high sensitivity; a large δ, a low sensitivity.

[6]A description of this method is given in Woodworth, R.S.: Experimental Psychology, Henry Holt and Co., N. Y., 416-417, 1938.

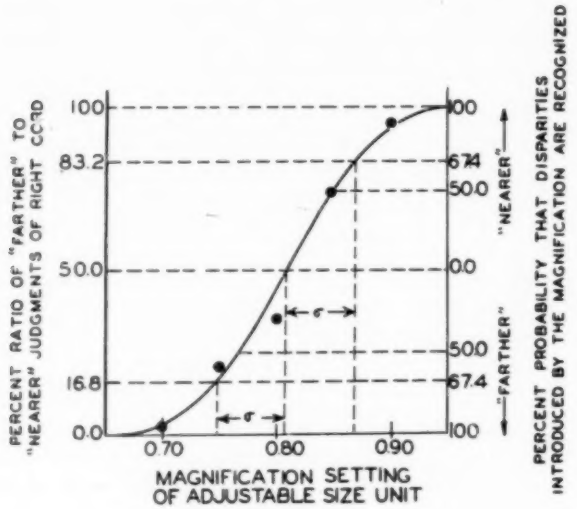

FIG. 3

Fig. 3. Typical psychometric curve obtained in determining the stereoscopic sensitivity with vertical cords for changes in the magnification of the image of the right eye in the horizontal meridian.

RESULTS

For all of the experiments in this investigation three subjects were employed. Two of the three had considerable practice and training in stereoscopic experiments while the third subject, N. W., had no previous training.

The principal results of this investigation are given in Table I. These show that the standard deviation (δ) at first decreases with an increase in the separation of the cords and then increases.

The significance of this change is somewhat difficult to appreciate since the resolving power of the eye decreases with an increase in the peripheral angle measured from the center of the visual field. It needs to be remembered, however, that while the visual acuity decreases with the peripheral angle, the disparity between the images in the two eyes introduced by magnifying the image in one eye will increase with the peripheral angle. Consequently, it is necessary to multiply the angle subtended by the two cords at the entrance pupil of the eye by the value of the standard deviation in order to obtain a measure of the stereoscopic sensitivity. When this is done, the results given in the last

TABLE I

(1) Separation of cords (cms.)	(2) Angular Separation of cords (secs.)	(3) Standard Deviation (% M)	(4) Standard Deviation (decimal x 10^{-3})	(2) x (4)
		SUBJECT V.J.E.		
5 (1.2°)	4,295	0.118	1.18	5.368
15 (3.6°)	12,875	0.079	0.79	10.17
25 (6.0°)	21,464	0.051 0.063	0.63	11.86 13.52
38 (9.0°)	33,186	0.061	0.61	20.24
50 (11.9°)	42,810	0.061	0.61	26.11
64.2 (15.2°)	54,843	0.069	0.69	36.20
75 (17.3°)	63,928	0.071	0.71	45.39
		SUBJECT K.N.O.		
5	4,295	0.128	1.28	5.50
25	21,464	0.080	0.80	17.15
50	42,810	0.059	0.59	25.28
		SUBJECT N.W.		
5	4,295	0.124 0.105 0.081	1.24 1.05 0.81	5.33 4.51 3.48
15	12,875	0.065	0.65	8.37
25	21,464	0.053	0.53	11.40
50	42,810	0.051 0.052 0.054	0.51 0.52 0.54	21.86 22.26 23.12
64.2	54,843	0.057	0.57	31.26

Table I. Tabulation of data which indicate stereoscopic sensitivities for changes in the relative size of the images in the two eyes in the horizontal meridian. The repeatability of the measurements should be noted.

column of Table I are obtained. These clearly show that the stereoscopic sensitivity markedly decreased with an increase of the peripheral angle. For a graphical comparison of the data of all the subjects, Figure 4 was prepared. It is apparent that the results of the three subjects are essentially the same.

Before a comparison can be made between the values for peripheral stereoscopic sensitivity and peripheral visual acuity, it is necessary to provide a similar unit of measure for the two functions. This can be done by using the reciprocal of the stereoscopic sensitivity measured in seconds of arc. Such a value might be called the binocular or stereoscopic acuity since the reciprocal of the resolution threshold (measured in minutes of visual angle) is a quantitative expression for visual acuity.

Even though the reciprocal values of the resolution threshold for visual acuity and the standard deviation for stereoscopic acuity are employed, there is a possibility that none of the values would be equal for any peripheral angle. If this occurred it would then be necessary

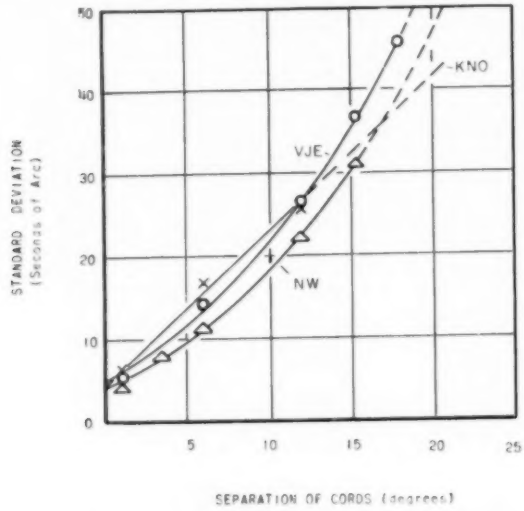

Fig. 4. Illustration of the change in stereoscopic sensitivity at different separations of the cords. The measure of the sensitivity is the standard deviation in seconds of arc.

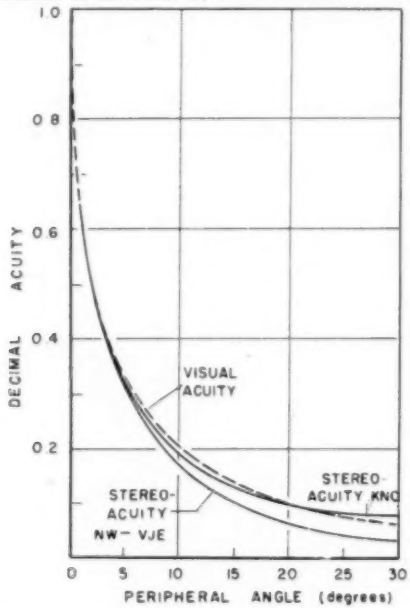

Fig. 5. A comparison of peripheral visual and stereoscopic acuities. The visual acuity data is from Wertheim. The data for the stereoscopic acuities are interpolated values from the results given in Fig. 4.

to equate the curves of the two acuities for a given peripheral angle and note the closeness to fit the remainder of the curves.

The above procedure was followed with the data of the three subjects used in the investigation. In fact, these results together with the values of the peripheral visual acuity as provided by Wertheim are given in Figure 5.[7] For these data, the stereoscopic acuity was equated for a peripheral angle of 2.5° and all the curves plotted on the same graph. Without any doubt, the curves of the monocular visual acuity and stereoscopic acuity are markedly similar.

[7]Wertheim, Z. F., Psy. Phys. Sinnes., 7:172, 1894.

ABSTRACTS

AN OPTOMETRIC APTITUDE TEST. N. D. Warren and A. A. Canfield. (University of Southern California.) Educational and Psychological Measurement. 8.2.183-191. 1948.

A review of medical and engineering literature indicated that tests for training in medicine stressed verbal achievement of the applicant, and those in engineering stressed the mathematical achievement. Since optometry seems to combine studies related to both of these fields, it was considered logical to make some measurement of these two factors in the aptitude test for optometry. Furthermore, a "job analysis" was made on practicing optometrists in Los Angeles and the curriculum of an optometry school was examined carefully.

As a result of the above exploratory investigations a five-part test was constructed to determine the following characteristics: general level of scientific information; scientific interest and attitude; certain personality factors, such as attention to detail, accuracy of work, speed of work, etc.; amount of general information in fields other than science; mathematical ability; and, ability to do fine work which demands close attention and accurate perception.

The primary purpose of the aptitude test was to determine whether or not prospective students would be able to assimilate the courses presented in an optometry school. The test was not designed to select those applicants who would do well in the practice of optometry or who would demonstrate rigid professional ethics.

The five parts of the aptitude test consisted of: (1) Figure Checking; (2) Personal History; (3) Mathematics; (4) Verbal Reasoning and Vocabulary; (5) Graph Reading. The test was given to two classes consisting of 65 senior optometry students and 82 junior optometry students.

The authors concluded that the *Optometric Aptitude Test* demonstrates a validity on the two samples of optometry students "that is very near .60" and which is thought to represent a fairly strong correlation. A general science knowledge seemed to be most closely related to successful training compared to the other types of abilities sampled by this test. Personal history, interests, and attitude items, as applied in this test, did not have consistent validity in predicting school grades from sample to sample. The number checking tests and the ability to read graphs accurately and quickly, indicated validity for selecting optometry students and the ability to do mathematical problems involving reasoning was indicative of success in the study of optometry.

It is suggested that the *Optometric Aptitude Test* be used with other indices of student promise such as scholastic and social records, recommendations by competent and ethical optometrists, and personal interviews which reveal the students' attitude toward the profession.

R. E. B.

REDUCING A CYLINDRICAL CORRECTION*

Howard T. Lewis†
Brooklyn, New York

In the course of performing refractions, the need often presents itself for modifying or reducing the cylindrical value indicated by objective and subjective findings. There has been little written in texts and papers on ocular refraction giving any specific technique for this procedure.

Such factors as "against-the-rule cylinders appearing in presbyopes," "high astigmats getting their first correction," "patients disturbed by astigmatic distortion," often necessitate optometrists deciding upon some lens combination that will have a lower cylindrical amount, but yet provide some of the correction for the ametropia which is responsible for the visual or asthenopic symptoms. Many optometrists work out their final cylindrical correction on the basis of judgment and trial and error tests in the individual case. However, a need exists for a rational technique which would make evident some definite criteria and at the same time be rapid enough to eliminate excessive trial and error tests. With this in mind, the following discussion and procedure is presented.

The theoretical picture of astigmatism of a point-source image is represented by the interval of Sturm, Figure 1. While this is a theo-

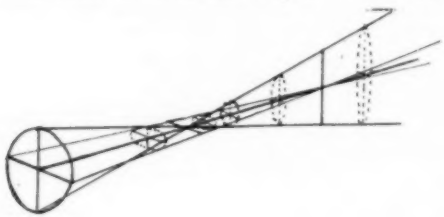

Fig. 1. Interval of Sturm.

retical representation, and in the human eye not strictly valid, for purposes of our discussion it will serve suitably.

From Figure 1 it can be seen that that blur circle which is a true circle or circle of least confusion, lies at the mid-point of the interval of Sturm. An analogous situation exists in the eye when, in a case of

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†Optometrist.

mixed astigmatism, the two principal focal lines straddle the retina equally. This can be represented diagrammatically as in Figure 2.

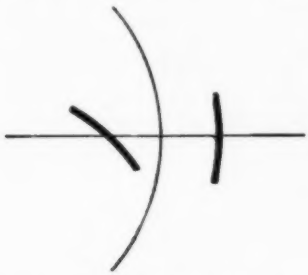

Fig. 2. Principal focal lines straddling retina in case of mixed astigmatism.

When this unique situation is present, it could cause the uncorrected acuity of a patient to be higher than would be anticipated on the basis of the numerical value of the correcting cylinder. That this is a fact, is borne out often in clinical experience.

Similarly, there is the possibility of simple and compound hyperopic astigmats accommodating in order to place the circle of least confusion in the plane of the retina. This situation is illustrated in Figure 3. This phenomenon can also be observed in practice.

This can further be evidenced by considering what happens in some cases of young hyperopic astigmats with moderate or high cylinders. The fogging tests (where acuity is no criterion) will often show much more plus sphere and more cylinder than the non-fogging tests (where acuity alone is the control factor). Thus, the static retinoscope finding and T-chart astigmatic test might show one or two diopters more plus sphere and more cylinder, while the net dynamic retinoscope finding, cross cylinder check test (flip cross cylinder) and the distance subjective could show less plus sphere and less cylinder.

Thus, we can see that the uncorrected ametropic eye attempts in some circumstances to create mixed astigmatism in order to secure maximum visual acuity. Conversely, it is possible, in an emmetropic or fully corrected ametropic eye, for the optometrist to create mixed astigmatism in small amounts and not significantly decrease the acuity. The rate of decrease in acuity for increasing amounts of mixed astigmatism created will depend upon the resolving power of the individual eye.

Let us take as an example, a compound hyperopic astigmat, age 32, whose correcting lens would be:

$+ 2.00$ D. sph. $\bigcirc + 3.00$ D. cyl. axis 90.

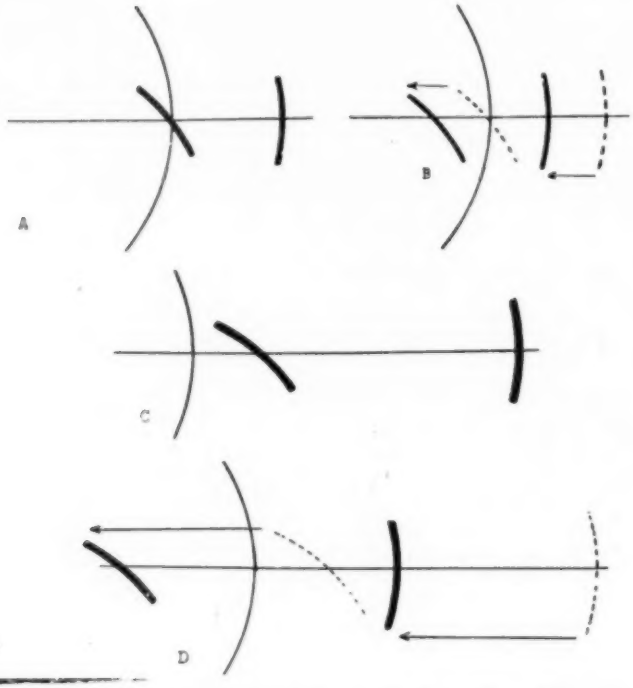

Fig. 3. (A) Position of principal focal lines in simple hyperopic astigmatism with no accommodation in force. (B) Position of principal focal lines in simple hyperopic astigmatism with slight accommodation in force. (C) Position of principal focal lines in compound hyperopic astigmatism with no accommodation in force. (D) Position of principal focal lines in compound hyperopic astigmatism with slight accommodation in force.

The refracting power in the principal meridians would then be:

180th meridian = + 5.00 D.
90th meridian = + 2.00 D.

With the correcting lens in place, both focal lines will fall on the retina as in Figure 4.

In order to cause each focal line to shift 1 diopter in opposite directions so that they would straddle the retina as in Figure 5, the power in each meridian would have to be changed to as follows:

180th meridian = + 4.00 D.
90th meridian = + 3.00 D.

The resulting correcting lens would then be:

+ 3.00 D. sph. ⊂ + 1.00 D. cyl. axis 90.

This has resulted in reducing the cylinder by 2 diopters.

Fig. 4.

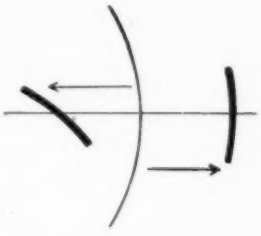

Fig. 5.

Since this is a desirable procedure in certain cases (i.e., to reduce the full subjective cylinder), a working rule can be stated:

When using plus cylinders: "Increase the plus (or decrease the minus) spherical amount by one-half the decrease in cylindrical amount." When using minus cylinders: "Decrease the plus (or increase the minus) spherical amount by one-half the decrease in cylindrical amount."

The use of the above rule will cause the focal lines to straddle the retina for any given amount of reduction in cylinder and should prove the most preferred lens formula for the cylinder prescribed.

The exception to this rule would be the case in which accommodation is so active that it would cause the eye to accommodate for the hyperopic focal line which is created (see Figure 6) causing the whole interval of Sturm to shift with the result as shown in Figure 6.

This would result in producing visual acuity decidedly less than the procedure would normally produce. In such a case, the patient's preference to the modified correction, as against one with a different spherical value, can be checked by adding to the spherical amount ± 0.25, ± 0.50, ± 0.75, etc., and comparing the reactions.

Now, while the above technique is valid and useful, it may require too many lens changes in a refractor or trial frame to effect each new lens combination that corresponds to each reduced cylinder to be checked.

The following technique is offered as an alternate: utilize a cross cylinder to create mixed astigmatism.

By placing the cross cylinder in front of the trial frame or refractor,

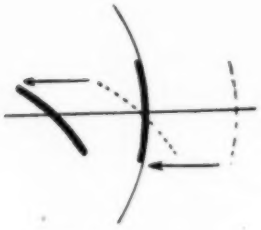

Fig. 6. Showing hyperopic focal line behind retina.

we can reduce the full cylinder correction and, at the same time, cause the focal lines to straddle the retina equally. With this lens in place, we can determine the patient's subjective reaction and visual acuity and quickly repeat the procedure with one or two other cross cylinders of different amounts and compare the results of one against the other. If the optometrist has available a set of 0.25, 0.50 and 0.75 cross cylinders, it will serve most of his needs.

The exact technique is as follows: Have the patient view, monocularly, the Snellen line of best acuity through the full subjective fiinding, which has been arrived at by use of all objective and subjective tests. To decrease the full cylinder, manually hold the lowest value cross cylinder in front of the refractor so that the plus axis is coincident with the axis on the refractor, when using minus cylinders, or the minus axis is coincident with the axis cylinder in its sphero-cylindrical form. We will then be reducing the full subjective cylinder by: 0.50 D. with a 0.25 D. cross cylinder. 1.00 D. with a 0.50 D. cross cylinder. 1.50 D. with a 0.75 D. cross cylinder.

With the first cross cylinder in place, note the visual acuity, patient's response of "drawing sensation," "floor tilts," "things look smaller," etc. Make the same observation with the second and third cross cylinder.

The reactions to these two or three modified corrections can then be compared with the factors of age, previous prescription and patient's symptoms. With this information the optometrist can come to a decision as to the most desirable cylinder to be included in the correction.

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HIGH DISTANCE VISUAL ACUITY WITH UNCORRECTED ASTIGMATISM — A CASE REPORT*

R. A. Phillips†
London, England

HISTORY

Mr. H. W. N., age 55, has spectacles for close work but cannot read well with them by artificial light. He obtained them five years ago, not having worn any before that. He has never worn a distance correction and feels that his unaided vision is still good enough. The eyes become sore sometimes, especially in windy weather. No complaint of pain in the eyes or of headache is made.

EXTERNAL EXAMINATION

No inflammation is present in the lids or conjunctiva. The iris pattern is distinct and the cornea clear. Tension is normal and the anterior chamber fairly deep for the age. The pupils are about 3 mm. in diameter and not very active either to light or accommodation.

Rotations are unrestricted and convergence to 10 cms. is possible.

OPHTHALMOSCOPY

The lens and vitreous contain no opacities. The disc is of good colour and outline with a small physiological cup in both eyes. The vessels are of normal caliber with no abnormalities at the crossings. The maculae are distinct and no pathological processes are present in any part of the fundi.

REFRACTION

Unaided vision: Distance: O.D. 20/30. O.S. 20/40. Near: O.D. J7, O.S. J7.

Retinoscopy: Distance:

O.D. + 3.50 D. sph. ⊂ —2.50 D. cyl. axis. 90.
O.S. + 4.00 D. sph. ⊂ —3.00 D. cyl. axis. 90.

Retinoscopy: Near.

O.D. + 5.50 D. sph. ⊂ —2.50 D. cyl. axis 100.
O.S. + 6.00 D. sph. ⊂ —3.00 D. cyl. axis 85.

Subjective findings:

O.D. + 3.75 D. sph. ⊂ —2.75 D. cyl. axis 95. V.A. 20/20.
O.S. + 4.00 D. sph. ⊂ —3.00 D. cyl. axis 95. V.A. 20/20.

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†Optometrist. Fellow, American Academy of Optometry.

Accommodation: O.D. 2.50 D. O.S. 2.50 D.

Fusion: Normal with distance correction.

Phorias: Distance. 1Δ exophoria, and ½Δ left hyperphoria.
Near: 4Δ exophoria, no hyperphoria.

Ductions: Distance: Abduction 10/4, Adduction 12/4.
Near: Abduction 19/15, Adduction 20/10.
Right supra duction 4/1. Left supra duction 4/1.

DIAGNOSIS

The difficulty in reading by artificial light with the spectacles is due to their power being insufficient to cope with the increased presbyopia. The soreness of the eyes in windy weather is probably due to sensitivity of the tissues consequent on the strain of maintaining good vision in spite of the ametropia. It is remarkable that the vision should be so good without correction, in view of the amount of astigmatism present. This high quality of unaided vision is difficult to account for. It is not due to smallness of pupils as they are relatively large when dilated and do not contract very much. It does not seem to be due to compensatory astigmatism, as the cylindrical findings are constant throughout the examination with the exception of slight variations in the axes. Nor is it due to the astigmatism being against-the-rule, as astigmatism with-the-rule would give better unaided vision, owing to the preference for vertical lines. Simulation of the defect in the writer's case gives poor 20/60 vision, but it is probable that a lifetime of seeing with astigmatic eyes and a robust constitution enables the better vision to be obtained.

TREATMENT

Prescription of the subjective findings for distance vision, with the axes at 90 as they are variable and to prevent distortion. An addition of 2 D. for each eye for reading at 36 cms.

SUMMARY

This is a case of increased presbyopia causing difficulty in reading with spectacles which are five years old.

The only unusual feature is that, with 3 D. of inverse hyperopic astigmatism, unaided vision is O.D. 20/30, O.S. 20/40.

This is not due to smallness of pupil or to compensatory astigmatism, but seems to be due to good interpretation of blurred images owing to a lifetime of use.

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EXCERPTA MEDICA—A NEW SERVICE

A common experience of anyone who attempts to keep abreast with the present day literature in a specific field or makes a thorough biographical study of a certain problem is the difficulty encountered in locating and evaluating the probable worth of published papers and articles. Of inestimable aid in locating pertinent papers relative to diagnosis, treatment and therapy is the INDEX MEDICUS. It has been published by the American Medical Association under the title of the QUARTERLY CUMULATIVE INDEX MEDICUS for many years. However, this publication is of limited use for evaluation since it provides only a tabulation and grouping of papers relating to specific subjects as well as their location and time of publication.

Since many papers are published in journals which are not readily

accessible, the need for abstracting services is apparent.[1] These have been provided in various ways. For example, many monthly journals devoted principally to the publication of original papers allocate space for abstracts to familiarize their readers with the publication of reports in other journals. Also, a limited number of journals publish only abstracts. The obvious purpose of an abstracting journal is the presentation of only the most essential material of a maximum number of papers. By the use of an abstract the reader can more accurately determine the probable value of a publication for his needs.

Although a number of abstracting journals have appeared since the termination of World War II, the most comprehensive and prompt abstracting of the medical literature of the world thus far available is the EXCERPTA MEDICA.[2] This publication was made possible by a subsidy from the government of the Netherlands in 1947. It is published monthly, in English, in 15 sections and covers the whole field of clinical, theoretical, and experimental medicine. Many hundreds of abstractors throughout the world cooperate in this project. The organization, which is under the general editorship of M. W. Woerdeman, professor of anatomy and embryology at the University of Amsterdam, is nonprofit.

One section of the EXCERPTA MEDICA, SECTION XII, is devoted to ophthalmology. In this section the material is classified as follows:

1. Textbooks, manuals, and monographs.

2. The History of Ophthalmology: Ophthalmology in its relation to the visual arts.

3. Normal systematic and topographical anatomy, comparative anatomy, and the embryology and ontogenetic development of the visual apparatus and ocular adnexa.

4. General and experimental physiology and pathology of the eye. (a.) The biochemistry of the eye. (b.) The vegetative physiology and pathology of the eye: sensitivity, ocular tension, metabolism. (c.) The action of light upon the structures of the eye: reflexes. (d.) Physical optics: accommodation and refraction: the prescription of glasses. (e.) General theories of physiological optics: light and color sense. (f.) Visual acuity: the sense of space.

5. Methods of examination: slit lamp biomicroscopy: optical instruments.

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[1] A list of the serial publications in the field of visual science was prepared by Dr. H. W. Hofstetter in 1947. The list included 419 publications. Although a number of these were published in the English language, a large percentage appeared only in a foreign language.

[2] Editorial—Indexes and Abstracts of Medical Literature. J.A.M.A., 139: 1080, 1949.

6. Hygiene and social medicine; hospital care and the welfare of the blind; geographical and statistical studies; military and industrial eye problems.

7. Special clinical ophthalmology. (a.) Aetiology. (b.) Topography.

8. Therapeutics and pharmacology.

From a study of this classification, it is seen that a major portion is devoted to subjects in which both ophthalmology and optometry are fundamentally concerned. Due to this common interest an invitation was made by the editors of EXCERPTA MEDICA to include this publication in those abstracted under the general section of ophthalmology. This invitation was accepted and now the material from the AMERICAN JOURNAL OF OPTOMETRY is included in the various monthly journals.

The EXCERPTA MEDICA is available to every optometrist. The abstracts published in this journal are of unquestionable value since they are prepared by some of the foremost authorities in ophthalmology throughout the world. Without any doubt the consistent use of the EXCERPTA MEDICA by an optometrist in practice significantly would aid him to keep abreast with developments throughout the world and enable him to better appreciate the contributions of investigators of many lands to his field of specialization.

It is a privilege for the AMERICAN JOURNAL OF OPTOMETRY to be a publication which will be continually abstracted for use in this international abstracting service. It is a hope that many optometrists will avail themselves of this excellent and noteworthy service.*

*Editor's Note:— Excerpta Medica, Section XII, Ophthalmology, may be secured through the American agents, The Williams & Wilkins Company, Mount Royal and Guilford Avenues, Baltimore 2, Maryland. Published monthly in annual volumes, $15.

V. J. ELLERBROCK.

A CHRISTMAS WISH FROM THE STAFF

While paging through an old world almanac the other day we were struck by the similarity of events in the world year after year. The year we were reading—1919—could have been, except for names, almost any year in the Twentieth Century. Each year the story is about the same: strikes, murders, floods, droughts, wars, peace pacts, new scientific achievements, etc. And each year, there are the same holidays: New Year's, the Fourth of July, Labor Day, Thanksgiving, Christmas. Yet, somehow, each year is unique: each holiday new and significant—especially Christmas and New Year's.

During the Christmas season each year, we look back on the months just past and realize it has been a better-than-ever year for optometry and for our Journal. Each year, we feel closer to our readers, ever more appreciative of the interest shown in our magazine; more grateful for the letters of criticism and praise. And always, about this time, we again search for a fresh and more meaningful way to wish our readers the very best for the coming year. Then, after reflection, we realize that nothing we could say would mean quite so much as the timeless greetings exchanged by men for centuries during the Holiday Season. So once again, we say to our readers, "Merry Christmas and Happy New Year!" and may 1950 be prosperous for you.

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

A NEW CARE SERVICE FOR EUROPE

It's common knowledge that scientific progress in war-torn areas of the world has lagged because of lack of men and facilities to carry on research. If you've been wondering how you, as a member of a scientific profession, can help speed up scientific progress abroad, CARE* has the solution. With the aid of organizations such as the American Association for the Advancement of Science, and in collaboration with UNESCO, CARE is making its facilities available for sending the latest technical and professional information to overseas libraries, universities and research groups.

Contributions from individuals or groups are used by CARE to purchase new scientific books to send overseas to replace those destroyed during the war. War demolished thousands of schools, gutted countless libraries and museums, and destroyed millions of books. In Prague, for example, the Research Institute of Medical History, Charles University, lost 16,000 of its 20,000 volumes. The University Library in Vienna lost 150,000 volumes, and the University Library of Louvain, Belgium, lost 900,000 volumes.

America cannot replace lost treasures, but we can share the scientific progress of this country during the last 10 years. As we originally gained our scientific heritage from Europe, it is only right that we

*Cooperative for American Remittances to Europe, Inc.

take advantage of this opportunity to repay some of the debt.

Interested individuals and organizations should contact CARE, Book Program, 20 Broad Street, New York 5, New York.

NEWS BRIEFS

Another lively, readable issue of the A. O. A.'s revamped *Visual Digest* is off the press. Contributors to the Fall issue are some of optometry's best known writers: Dr. Ralph Wick, Rapid City; Dr. Marguerite Eberl, Milwaukee; Dr. Emmett Betts, Temple University, and others. Dr. Elmer Soles, A. O. A.'s public information director, and Dr. Ernest Kiekenapp, A. O. A. secretary, are carrying on the work of the *Digest* following resignation of Dr. Walter Kimball and his wife, Madge, who edited the magazine for 11 years. Smaller size, glossier paper, and a more varied typography lend new sparkle to this publication, which is now published in Minneapolis, at 518 Wilmac Building. . . . Also for lay readers is a new book by Dr. Harris Gruman, *New Ways to Better Sight*, which tells the reader about visual care from the optometric standpoint. Optometrist-author Gruman is from Lebanon, Pennsylvania. . . . The California Optometric Association co-sponsored an educational seminar December 4th with the Alameda and Contra Cost Counties Optometric Association. Speakers were Dr. Arthur Jampolsky, Dr. Henry Hofstetter, and Dr. Stanley Diamond. . . . The School of Optometry at the University of California, Berkeley, has started an extension class to help students improve reading skills. . . . Dr. Conrad Berens, New York City, was awarded the 1949 Leslie Dana Medal for the Prevention of Blindness. The award is made annually by the St. Louis Society for the Blind in cooperation with the National Society for the Prevention of Blindness and the Association for Research in Ophthalmology.

OPTOMETRISTS IN THE NEWS

Dr. Robert Graham, faculty member of the Los Angeles College of Optometry, recently discussed corneal lenses for football players on a West Coast television show, "Football Huddle." The ABC program is m.c.'d by Tom Harmon. . . . Named co-directors of a new Institute for Research in Vision are Dr. Glenn Fry, director, School of Optometry, and Dr. Arthur M. Culler, chairman, Department of Ophthalmology, the Ohio State University. The two men will coordinate research at the University in visual science and other fields. The Institute will be housed in the new Optometry building. . . . Dr. Louis Kraskin, Washington, D. C., has received an honorary life membership in

Gamma Omega Phi in recognition of his contributions to optometry. . . . Dr. Matthew Luckiesh, director of General Electric's Lighting Research Laboratory, has announced his retirement effective December 31, 1949. Dr. Luckiesh affiliated with GE in 1910 as physicist in the research laboratories, and has served in his present position since 1924. . . . Dr. Carel Koch, Minneapolis, was the dinner speaker at a joint meeting of the Iowa and Minnesota chapters of the American Academy of Optometry on November 7. Drs. Fay M. Whitsell and Fred Kushner of Northern Illinois College of Optometry, and Dr. A. R. Lauer, Professor of Psychology, Iowa State College, presented papers at the two-day session.

NEW YORK GROUP SPONSORS NIGHT COURSES

Well under way as we go to press is the New York City Optometric Foundation night graduate courses for practicing optometrists. On December 2, the Foundation began courses in orthoptics under the direction of Dr. Isidore Finkelstein, and contact lenses under Dr. Milton Chodroff. Drs. F. W. Brock, Ernest Giglio, Mark Graubart will assist in the orthoptics section: Drs. L. Lester Beacher, George Hellinger, William Feinbloom, Samuel Silverstein, Harry Berenholtz and Robert Taub, the contact lens section.

Officials of the Foundation report that about 40 per cent of the optometrists in the New York area have participated in the study groups in the past.

The members of the Foundation tentatively are planning the establishment of a referral center for optometrists based on a plan similar to the London Refraction Hospital in England.

Information about future courses scheduled by this Foundation may be obtained from The Optometric Foundation, Room 304m, Paramount Building, New York 10, New York.

ACADEMY CONVENTION REPORT IN JANUARY

As you read this Christmas issue, staff writers of the Journal are busy writing up their notes from the recent convention of the American Academy of Optometry, so we can give you a full report in January. Watch for it in "Transactions of the Academy" department.

VOLUME 26, 1949, GENERAL INDEX

This is an index covering all of the departments of the AMERICAN JOURNAL OF OTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY. The letters used to explain in which department the material indexed appears are as follows: (OP), Original Paper; (E), Editorial; (T), Transactions of the Academy; (CC), Current Comments by Virginia Huck; (SR), Special Reports; (C), Correspondence; (Ab), Abstracts; (BN), Book Notices; and (A), Announcements.

A

Abraham. S. V. Classification of nonparalytic strabismus. (Ab) 444
Accommodation and convergence and the pupillary near reflex. E. Marg and M. W. Morgan. Jr. (OP) 183
Accommodation and convergence, changes recorded by photographic technique. M. J. Allen. (OP) 279
Accommodation and convergence, pupillary changes associated with. H. A. Knoll. (OP) 346
Accommodation and convergence with contact lenses. M. Alpern. (OP) 379
Accommodative-convergence gradient, statistical analysis of. A. B. Emmes. (OP) 474
Accommodation, negative. J. I. Pascal. (Ab) 499
Acker. F. W. Orthoptic training used in correction of latent hyperopia and exophoria, a case report. (OP) 260
Allen. M. J. Photographic technique for simultaneously recording changes in accommodation and convergence. (OP) 279
Alpern. M. Accommodation and convergence with contact lenses. (OP) 379
Amblyopia, anomalous fixation in. T. R. Murroughs. (Ab) 86
Amblyopia, occlusion in treatment of. Five case reports. M. K. Eakin and R. S. Eakin. (OP) 400
Amblyopia, psychological aspects of. L. Wekstein. (OP) 511
American Academy of Optometry. Annual report of President. H. M. Fisher. (T) 38
American Academy of Optometry. Annual report of Secretary. C. C. Koch. (T) 39
American Academy of Optometry. Cleveland annual meeting. (T) 278-323-455-496
American Academy of Optometry. Committee appointments for 1949. (T) 43-89
American Academy of Optometry. Contact lens section. (T) 88
American Academy of Optometry joins American Association for the Advancement of Science, V. Huck. (CC) 409
American Academy of Optometry. New members. (T) 36-181-323-457
American Academy of Optometry. Poll on compulsory health insurance. (T) 499
American Academy of Optometry. Procedure to be followed in applying for membership in. A. P. Wheelock. (E) 264
American Academy of Optometry. Report of meeting at Winston-Salem. (T) 31
American Academy of Optometry. Report of research projects committee. (T) 87
American Association for the Advancement of Science. American Academy of Optometry joins. V. Huck. (CC) 409
American Optometric Association, convention report. R. E. Bannon. (SR) 319
American Optometric Association policy needed on Ewing compulsory health proposals. C. C. Koch. (E) 215
American Optometric Foundation announcement of fellowships. W. C. Ezell. (SR) 408
Ametropia and pupil size. M. J. Hirsch and F. W. Weymouth. (Ab) 426
Aniseikonia and binocular vision. R. E. Bannon. (OP) 240
Aniseikonia, method of measurement and case report. (OP) 78
Aniseikonia, modification of the space-eikonometer technique. H. M. Fisher. (OP) 137
Aniseikonia, report on three cases of. O. L. McCulloch. (OP) 338
Aniseikonic Forum reviews policies. R. E. Bannon. (SR) 500
Aniseikonic practitioners, geographical directory of. (SR) 501
Anisometropia. Case report demonstrating effects of improper correction. M. J. Hirsch. (OP) 447
Aptitude test, optometric. N. D. Warren. (Ab) 537
Arkansas Chapter. American Academy of Optometry. (T) 90-499
Arneson Korector. T. J. Arneson. (BN) 357
Asthenopia, refractive treatment of. P. W. Miles. (Ab) 529
Astigmatism, high distance visual acuity with uncorrected—A case report. R. A. Phillips. (OP) 543
Astigmatism, modification of Javal's rule for the correction of. J. D. Kratz and W. G. Walton. (OP) 295

B

Baker. H. DeH. Light adaptation measured by threshold intensity increment. (Ab) 201
Banes. S. Stimulation to overcome suppression. (Ab) 102
Bannon. R. E. American Optometric Association convention report. (SR) 319
Bannon, R. E. Aniseikonia and binocular vision. (OP) 240

Bannon, R. E. Aniseikonic Forum reviews policies. (SR) 500
Bannon, R. E. "Clinical Refraction" by Borish. (E) 171
Bannon, R. E. Individual responsibility for commercialism in optometry. (E) 83
Bannon, R. E. Optometric education. (E) 492
Bannon, R. E. Report of the research projects committee. American Academy of Optometry. (T) 87
Bannon, R. E. and Treleaven, C. L. Obstacles to binocular vision. (Ab) 102
Barnes, H. R. Fundamentals of practical optometry. (BN) 225
Baxter, J. O. Professional fees and basic charges for materials. (SR) 218
Betts, E. A. and Dorris, V. Visual acuity in the Navy. (Ab) 208
Bier, N. High myopia and vertical phoria corrected with contact lenses. (OP) 290
Bier, N. Ventilated contact lenses. (OP) 120
Bifocal segments, placement of. R. Graham. (OP) 101
Bifocals for prepresbyopic patient with visual fatigue. A case report. J. R. Hubbard. (OP) 312
Binocular vision and aniseikonia. R. E. Bannon. (OP) 240
Binocular vision, obstacles to. C. L. Treleaven and R. E. Bannon. (Ab) 102
Black, S. Importance of small errors of refraction. (Ab) 387
Bloomfield, S. Therapeutic results in glaucoma with telescopic fields. (Ab) 507
Boeder, P. Rudolph Luneburg 454
Books received, a listing on new 510
Bridgman, C. S., Ellerbrock, V. J. and Fry, G. Effects of atmospheric scattering on binocular depth perception. (OP) 9
British health program, demoralizing, observer finds. V. Huck. (CC) 91
British national health service, analysis of cases in. H. Freeman. (Ab) 211

C

Chapanis, A. Comparative study of five tests for color vision. (Ab) 131
Chapanis, A. Stability of "improvement" in color vision due to training. Report of three cases. (OP) 251
Christmas wish from the staff. (E) 547
Clarke, H. M. Student's viewpoint on professional practice. (SR) 274
"Clinical Refraction" by Borish. R. E. Bannon. (E) 171
Coleman, H. S. Resolution of human eye. (Ab) 509
Color blindness, effect of training. F. McCord. (Ab) 26
Color blindness, report on training. F. McCord. (Ab) 74
Color vision, stability of "improvement" in, due to training. Report of three cases. A. Chapanis. (OP) 251
Color vision, study of five tests. A. Chapanis. (Ab) 131
Commercialism in optometry, individual responsibility for. R. E. Bannon. (E) 83
Compulsory health insurance. V. Huck. (CC) 174
Compulsory health insurance, alternative to. C. C. Koch. (E) 128
Compulsory health insurance by Ewing, A. O. A. policy needed on. C. C. Koch. (E) 215
Compulsory health insurance, notes on. R. W. Tubesing. (SR) 271
Contact lens in goiter, a case report. R. Irving. (OP) 103
Contact lens practice, regulation of. R. A. Tyler Jones. (Ab) 407
Contact lens section, American Academy of Optometry. (T) 88
Contact lenses, accommodation and convergence with. M. Alpern. (OP) 379
Contact lenses, correction of high myopia and vertical phoria. A case report. N. Bier. (OP) 290
Contact lenses, effects on neuro-muscular patterns of vision. L. E. Firestone and E. M. Gaynes. (OP) 95
Contact lenses, ventilated. N. Bier. (OP) 120
Conventions, optometric, change in policy needed for commercial exhibits at. C. C. Koch. (E) 317
Convergence and accommodation, changes recorded by photographic technique. M. J. Allen. (OP) 279
Convergence and accommodation, pupillary changes associated with. H. A. Knoll. (OP) 346
Convergence and accommodation with contact lenses. M. Alpern. (OP) 379
Corneal lens. R. Graham. (OP) 75
Current comments. V. Huck. 47-91-132-174-227-276-324-365-409-457-502-548
Cylindrical correction, reducing a. H. T. Lewis. (OP) 538

D

Depth perception, binocular, effects of atmospheric scattering on. G. A. Fry, C. S. Bridgman and V. J. Ellerbrock. (OP) 9
Dorris, V., and Betts, E. A. Visual acuity in Navy. (Ab) 208
Driving ability, effect of measuring. E. D. Fletcher. (Ab) 263

E

Eakin, M. K. and Eakin, R. S. Use of occlusion in treatment of amblyopia. Five case reports. (OP) 400
Eames, T. H. Relationship of refractive errors to speed of perception of objects and words. (Ab) 343
Eastern Pennsylvania Chapter, American Academy of Optometry. (T) 90-278
Eberl, M. T. School children's vision. (Ab) 160
Education and vision. F. O. Polte. (Ab) 143
Education for what is real. E. C. Kelley. (BN) 135

Ellerbrock, V. J. Comparison of peripheral stereoscopic and visual acuities. (OP) 530
Ellerbrock, V. J. Excerpta Medica—A new service. (E) 545
Ellerbrock, V. J. Investigation of vertical fusional movements. (OP) 327-388
Ellerbrock, V. Visual training program at Ohio State. (C) 56
Ellerbrock, V. J., Fry, G., and Bridgman, C. S. Effect of atmospheric scattering on binocular depth perception. (OP) 9
Elvin, F. T. Aniseikonia, method of measurement and case report. (OP) 78
Emmes, A. B. Statistical analysis of accommodative-convergence gradient. (OP) 474
Englehart, E. Psychosis. (Ab) 46
Ethics, foundations of professional. E. Freeman. (OP) 161
Ewing compulsory health proposals. A. O. A. policy needed on. C. C. Koch. (E) 215
Examination record form. H. W. Hofstetter. (OP) 22
Excerpta Medica—A new service. V. J. Ellerbrock. (E) 545
Exhibits, commercial, at optometric conventions, change in policy needed for. C. C. Koch. (E) 317
Exophoria and latent hyperopia, orthoptic training used in correction, a case report. F. W. Acker. (OP) 260
Eye care, student's need for. J. Tiffin. (Ab) 444
Eye, resolution of. H. S. Coleman. (Ab) 509
Ezell, W. C. American Optometric Foundation announcement of fellowship. (SR) 408

F

Fatigue, visual, bifocals for prepresbyopic patient with. A case report. J. R. Hubbard. (OP) 312
Fees, professional and basic charges for materials. J. O. Baxter. (SR) 218
Feinberg, R. Peripheral visual acuity. (OP) 49-105
Fisher, H. M. Annual report of President, American Academy of Optometry. (T) 38
Fisher, H. M. Modification of the space-eikonometer technique. (OP) 137
Firestone, L. E. and Gaynes, E. M. Contact lenses, their effect on neuro-muscular patterns of vision. (OP) 95
Fletcher, E. D. Effect of measuring driving ability. (Ab) 263
Florida Chapter, American Academy of Optometry. (T) 278
Foveal light adaptation measured by threshold intensity increment. H. DeH. Baker. (Ab) 201
Freeman, E. Foundations of professional ethics. (OP) 161
Freeman, H. Analysis of British national health service cases. (Ab) 211
Friedenberg, H. L. Subnormal vision device in hypertension. A case report. (OP) 212
Friedenberg, H. L. Telescopic spectacles, application of, three case reports. (OP) 3
Fry, G. A. Standardization of lens shapes. (Ab) 214
Fry, G., Bridgman, C. S. and Ellerbrock, V. J. Effects of atmospheric scattering on binocular depth perception. (OP) 9
Fundamentals of practical optometry. H. R. Barnes. (BN) 225
Fusional movements, investigation of vertical. V. J. Ellerbrock. (OP) 327-388
Fusional Vergence. E. F. Tait. (Ab) 508

G

Gaynes, E. M. and Firestone, L. E. Contact lenses, their effect on neuro-muscular patterns of vision. (OP) 95
Glasses are his hobby. (Ab) 259
Glasses, occupational. J. W. Overton. (Ab) 239
Glaucoma with telescopic fields, simple, therapeutic results in. S. Bloomfield. (Ab) 507
Graham, R. Corneal lens. (OP) 75
Graham, R. Placement of bifocal segments. (OP) 101
Graham, R. Plastic lenses made of thermo-setting resins. (OP) 358
Grout, J. H. Experiment on nature of retinal image. (OP) 427
Grupposo, S. S. Report on Renshaw stereo-disparator. (OP) 307
Guth, S. K. and Luckiesh, M. Sensitometric method of refraction. (OP) 367

H

Haniford, S. S. Myopia control without bifocals. (OP) 19
Health insurance, compulsory, American Academy of Optometry poll on. (T) 499
Health insurance, compulsory, an alternative to. C. C. Koch. (E) 128
Health insurance no bonanza, government. V. Huck. (CC) 227
Health insurance, compulsory, notes on. R. W. Tubesing. (SR) 271
Heritage of optometry. C. C. Koch. (E) 451
Higgins, G. C. and Stultz, K. Visual acuity measured with parallel-line test object. (Ab) 127
Hirsch, M. J. Accuracy of reading rotary prisms. (OP) 27
Hirsch, M. J. Anisometropia. Case report showing effects of improper correction. (OP) 447
Hirsch, M. J. and Weymouth, F. W. Pupil size in ametropia. (Ab) 426
Hofstetter, H. W. New examination record form. (OP) 22
Hofstetter, H. W. Orthoptics specification by a graphical method. (OP) 439
Hofstetter, H. W. Practices in prescribing presbyopic adds. (OP) 144
Hofstetter, H. W. Visual complaints related to television, a survey. (OP) 483
Hubbard, J. R. Bifocals for prepresbyopic patient with visual fatigue. A case report. (OP) 312
Huck, V. American Academy of Optome-

try joins American Association for the Advancement of Science. (CC) 409
Huck. V. Charles Sheard. (E) 361
Huck. V. Compulsory health insurance. (CC) 174
Huck. V. Current comments 47-91-132-174 227-276-324-365-409-457-502-548
Huck. V. Government health insurance no bonanza. (CC) 227
Huck. V. Observer finds British health program demoralizing. (CC) 91
Hummel. D. G. (Frontispiece) 2
Hutchinson. E. A. Plea for program of prepaid health care. (SR) 222
Hyperopia (latent) and exophoria. orthoptic training used in correction. a case report. F. W. Acker. (OP) 260
Hypertension. subnormal vision device in. A case report. H. L. Friedenberg. (OP) 212

I

Illumination and visual acuity. J. I. Pascal. (Ab) 489
Image. retinal. experiment on nature of. J. H. Grout. (OP) 427
Indiana Chapter. American Academy of Optometry. (T) 90-499
Industrial (factory) optometrist. routine examination adapted to needs of. D. W. A. Mitchell. (Ab) 387
Infinity binocular balance test. Turville. M. W. Morgan. Jr. (OP) 231
Inhibitional palsies. J. I. Pascal. (Ab) 438
Iridectomy. telescopic spectacles to improve vision following. G. C. Wise. (OP) 445
Irving. R. Contact lens in goiter. A case report. (OP) 103
Irving. R. Refractive errors in identical twins. (OP) 344

J

Javal's rule for correction of astigmatism. a modification of. J. D. Kratz and W. G. Walton. (OP) 295

K

Kelley. E. C. Education for what is real. (BN) 135
Knoll. H. A. Pupillary changes associated with accommodation and convergence. (OP) 346
Koch. C. C. Alternative to compulsory health insurance. (E) 128
Koch. C. C. Annual report of Secretary. American Academy of Optometry. (T) 39
Koch. C. C. A.O.A. policy needed on Ewing compulsory health proposals. (E) 215
Koch. C. C. Change in policy needed regarding commercial exhibits at optometric conventions. (E) 317
Koch. C. C. Heritage of optometry. (E) 451
Koch. C. C. Nocturnal myopia. (E) 318
Koch. C. C. Research usually undramatic. (E) 405
Koch. C. C. "Squint" in the land of the Mayas. (E) 315
Koch. C. C. Visual training and sports. (E) 29
Korector. Arneson. T. J. Arneson. (BN) 357
Kratz. J. D. and Walton. W. G. Modification of Javal's rule for correction of astigmatism. (OP) 295

L

Lebensohn. J. E. Problems of presbyopia (Ab) 311
Lens shapes. standardization of. G. A. Fry. (Ab) 214
Lenses. ophthalmic. form and thickness considerations for various near points. F. W. Sinn. (OP) 202
Lewis. H. T. Reducing a cylindrical correction. (OP) 538
Lit. A. Application of psychological principles in optometric practice. (OP) 461
Luckiesh. M. and Guth. S. K. Sensitometric method of refraction. (OP) 367
Luneburg. R. (Obituary) P. Boeder 454
Lyle. T. K. Practical orthoptics in the treatment of squint. (BN) 506

M

Madigan. L. F. Distortions of space. (Ab) 306
Marg. E. and Morgan. M. W. Jr. Pupillary near reflex. (OP) 183
Mathematical table projector. J. W. Morris. (Ab) 46
McCleary. V. A. Socialized medicine. (SR) 363
McCord. F. Effect of training color blindness. (Ab) 26
McCord. F. Report on training color blindness. (Ab) 74
McCulloch. O. L. Report on three cases of aniseikonia. (OP) 338
Michigan Chapter. American Academy of Optometry. (T) 278
Miles. P. W. Refractive treatment of asthenopia. (Ab) 529
Mitchell. D. W. A. Routine examination adapted to needs of the factory optometrist. (Ab) 387
Morgan. M. W. Jr. Turville infinity binocular balance test. (OP) 231
Morgan. M. W. Jr. and Marg. E. Pupillary near reflex. (OP) 183
Morris. J. W. Mathematical table projector. (Ab) 46
Motion picture testing and research. Report No. 7. Army Air Forces. Aviation Psychology Section. (BN) 182
Murroughs. T. J. Anomalous fixation in amblyopia. (Ab) 86
Myopia and convergent squint. J. I. Pascal. (Ab) 345
Myopia control without bifocals. a case report. S. S. Haniford. (OP) 19
Myopia. effect of group training on. A. E. Sloane. (Ab) 508
Myopia. high. and vertical phoria corrected with contact lenses. A case report. N. Bier. (OP) 290
Myopia. night. thresholds of. J. M. Otero.

L. Plaza and F. Salavarri. (Ab) 294
Myopia, nocturnal. C. C. Koch. (E) 318

N

National health service (British) cases, analysis of. F. Freeman. (Ab) 211
Navy, visual acuity in. E. A. Betts and V. Dorris. (Ab) 208
Night myopia, thresholds of. J. M. Otero, L. Plaza and F. Salavarri. (Ab) 294
Nocturnal myopia. C. C. Koch. (E) 318
Northeastern Ohio Chapter. American Academy of Optometry. (T) 90
Northwest Pacific Chapter. American Academy of Optometry. (T) 457

O

Occlusion in treatment of amblyopia. Five case reports. M. K. Eakin and R. S. Eakin. (OP) 400
Occupational glasses. J. W. Overton. (Ab) 239
Ogle, K. N. Distortion of stereoscopic spatial localization. (Ab) 100
Optical correction, factors influencing demands for. J. R. Warman. (Ab) 399
Ophthalmic lens, slab-off, measurement with lens gauge. H. B. Peters. (OP) 16
Ophthalmic lenses, form and thickness considerations for various near points. F. W. Sinn. (OP) 202
Ophthalmic materials, charges for and professional fees. J. O. Baxter. (SR) 218
Optometric aptitude test. N. D. Warren. (Ab) 537
Optometric education. R. E. Bannon. (E) 492
Optometry, heritage of. C. C. Koch. (E) 451
Orthoptic training used in correction of latent hyperopia and exophoria, a case report. F. W. Acker. (OP) 260
Orthoptics specification by a graphical method. H. W. Hofstetter. (OP) 439
Otero, J. M., Plaza, L. and Salavarri, F. Thresholds of night myopia. (Ab) 294
Overton, J. W. Occupational glasses. (Ab) 239

P

Parkins, G. A. and Weeks, C. W. Changes in refraction accompanying changes of sugar in blood. (OP) 199
Pascal, J. I. Correction in measurement of strabismus. (Ab) 495
Pascal, J. I. Head tilt in strabismus. (OP) 490
Pascal, J. I. Illumination and visual acuity. (Ab) 489
Pascal, J. I. Inhibitional palsies. (Ab) 438
Pascal, J. I. Myopia and convergent squint. (Ab) 345
Pascal, J. I. Negative accommodation. (Ab) 499
Perception, speed of. Relationship between refractive errors and. T. H. Eames. (Ab) 343
Peripheral visual acuity. R. Feinberg. (OP) 49-105
Peters, H. B. Measurement of slab-off ophthalmic lens with lens gauge. (OP) 16
Phillips, R. A. High distance visual acuity with uncorrected astigmatism. A case report. (OP) 543
Photographic technique for recording changes in accommodation and convergence. M. J. Allen. (OP) 279
Plastic lenses made of thermosetting resins. R. Graham. (OP) 358
Plaza, L., Otero, J. M., and Salavarri, F. Thresholds of night myopia. (Ab) 294
Polte, F. O. Vision and education. (Ab) 143
Practical orthoptics in treatment of squint. T. K. Lyle. (BN) 506
Practice, professional, a student's viewpoint on. H. M. Clarke. (SR) 274
Prepaid health care, plea for program of. E. A. Hutchinson. (SR) 222
Presbyopia, problems of. J. E. Lebensohn. (Ab) 311
Presbyopic adds, practices in prescribing. H. W. Hofstetter. (OP) 144
Principles and practices of ophthalmic surgery. E. B. Spaeth. (BN) 68
Prisms, clinical indications for prescribing. R. T. Textor. (OP) 519
Psychological aspects of amblyopia. L. Wekstein. (OP) 511
Psychological principles, applications in optometric practice. A. Lit. (OP) 461
Psychosis. E. Englehart. (Ab) 46
Psychosomatic optometry with reports of subnormal vision cases. I. I. Vics. (OP) 57
Pupil size in ametropia. M. J. Hirsch and F. W. Weymouth. (Ab) 426
Pupillary changes associated with accommodation and convergence. H. A. Knoll. (OP) 346
Pupillary near reflex. E. Marg and M. W. Morgan, Jr. (OP) 183

R

Reading disabilities, emotional problems associated with. W. F. Schneider. (OP) 413
Refraction, changes accompanying changes of sugar in blood. C. W. Weeks and G. A. Parkins. (OP) 199
Refraction, importance of small errors of. S. Black. (Ab) 387
Refraction, sensitometric method of. M. Luckiesh and S. K. Guth. (OP) 367
Refractive treatment of asthenopia. P. W. Miles. (Ab) 529
Renshaw stereo-disparator, report on. S. S. Grupposo. (OP) 307
Research usually undramatic. C. C. Koch. (E) 405
Retinal image, experiment on nature of. J. H. Grout. (OP) 427
Robb, P. H. Stereoscope in training students. (Ab) 407
Roland, E. O. Subnormal vision due to vitreous hemorrhage. A case report. (OP) 209
Rotary prisms, accuracy of reading. M. J. Hirsch. (OP) 27

S

Salavarri, F., Otero, J. M., and Plaza, L. Thresholds of night myopia. (Ab) 294

Schneider, W. F. Emotional problems associated with reading disabilities. (OP) 413
School children's vision. M. T. Eberl. (Ab) 160
Sensitometric method of refraction. M. Luckiesh and S. K. Guth. (OP) 367
Sheard, Charles. V. Huck. (E) 361
Sinn, F. W. Form and thickness considerations for various near points in lenses. (OP) 202
Slab-off ophthalmic lens: measurement with lens gauge. H. B. Peters. (OP) 16
Sloane, A. E. Group training on myopia. (Ab) 508
Socialized medicine. V. A. McCleary. (SR) 363
Southern California Chapter, American Academy of Optometry. (T) 90-278-498
Space, distortions of. L. F. Madigan. (Ab) 306
Spaeth, E. B. Principles and practice of ophthalmic surgery. (BN) 68
Spatial localization, stereoscopic distortion of. K. N. Ogle. (Ab) 100
Spectral-Transmissive properties and use of eye-protective glasses. (BN) 460
Speed of perception of objects and words, relationship of refractive errors to. T. H. Eames. (Ab) 343
Springer, D. A. Visual skills testing in Piedmont public schools. (OP) 69
Squint, convergent and myopia. J. I. Pascal. (Ab) 345
"Squint" in the land of the Mayas. C. C. Koch. (E) 315
Stemp, A. A. M. Eyesight survey of Leaside school children. (Ab) 277
Stereo-disparator, Renshaw, report on. S. S. Grupposo. (OP) 307
Stereoscope, use in training students. P. H. Robb. (Ab) 407
Strabismus, classification of nonparalytic. S. V. Abraham. (Ab) 444
Strabismus, correction in measurement of. J. I. Pascal. (Ab) 495
Strabismus, head tilt in. J. I. Pascal. (OP) 490
Stulz, K. and Higgins, G. C. Visual acuity measured with parallel-line test object. (Ab) 127
Subnormal vision cases and psychosomatic optometry. I. I. Vics. (OP) 57
Subnormal vision device in hypertension. A case report. H. L. Friedenberg. (OP) 212
Subnormal vision due to vitreous hemorrhage. A case report. E. O. Roland. (OP) 209
Suppression, (neutralisation) stimulation to overcome. S. Banes. (Ab) 102

T

Tait, E. F. Fusional vergence. (Ab) 508
Telescopic spectacles, application of, three case reports. H. L. Friedenberg. (OP) 3
Telescopic spectacles to improve vision following iridectomy. A case report. G. C. Wise. (OP) 445
Television, visual complaints related to. H. W. Hofstetter. (OP) 483
Textor, R. T. Clinical indications for prescribing prisms. (OP) 519
Tiffin, J. Student's need for eye care. (Ab) 444
Treleaven, C. L. and Bannon, R. E. Obstacles to binocular vision. (Ab) 102
Twins, refractive errors in identical. R. Irving. (OP) 344
Tubesing, R. W. Notes on compulsory health insurance. (SR) 271
Turville, A. E. The week's work. (Ab) 399
Turville infinity binocular balance test. M. W. Morgan, Jr. (OP) 231
Tyler Jones, R. A. Regulation of contact lens practice. (Ab) 407

V

Vertical fusional movements, investigation of. V. J. Ellerbrock. (OP) 327-388
Vics, I. I. Psychosomatic optometry with reports of subnormal vision cases. (OP) 57
Vision and education. F. O. Polte. (Ab) 143
Vision, school children's. M. T. Eberl. (Ab) 160
Visual acuities, comparison of peripheral stereoscopic and. V. J. Ellerbrock. (OP) 530
Visual acuity in the Navy. E. A. Betts and V. Dorris. (Ab) 208
Visual acuity measured with parallel line test object. G. C. Higgins and K. Stultz. (Ab) 127
Visual acuity, peripheral. R. Feinberg. (OP) 49-105
Visual (eyesight) survey of Leaside school children. A. A. M. Stemp. (Ab) 277
Visual skills testing in Piedmont public schools. D. A. Springer. (OP) 69
Visual training and sports. C. C. Koch (E) 29
Visual training program at Ohio State. V. Ellerbrock. (C) 56
Vitreous hemorrhage, subnormal vision due to. A case report. E. O. Roland. (OP) 209

W

Walton, W. G. and Kratz, J. D. Modification of Javal's rule for correction of astigmatism. (OP) 295
Warman, J. R. Factors influencing demands for optical correction. (Ab) 399
Warren, N. D. Optometric aptitude test. (Ab) 537
Weeks, C. W. and Parkins, G. A. Changes in refraction accompanying changes of sugar in blood. (OP) 199
Wekstein, L. Psychological aspects of amblyopia. (OP) 511
Weymouth, F. W. and Hirsch, M. J. Pupil size in ametropia. (Ab) 426
Wheelock, A. P. Procedure to be followed in applying for membership in American Academy of Optometry. (E) 264
Wise, G. C. Telescopic spectacles to improve vision following iridectomy. A case report. (OP) 445
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